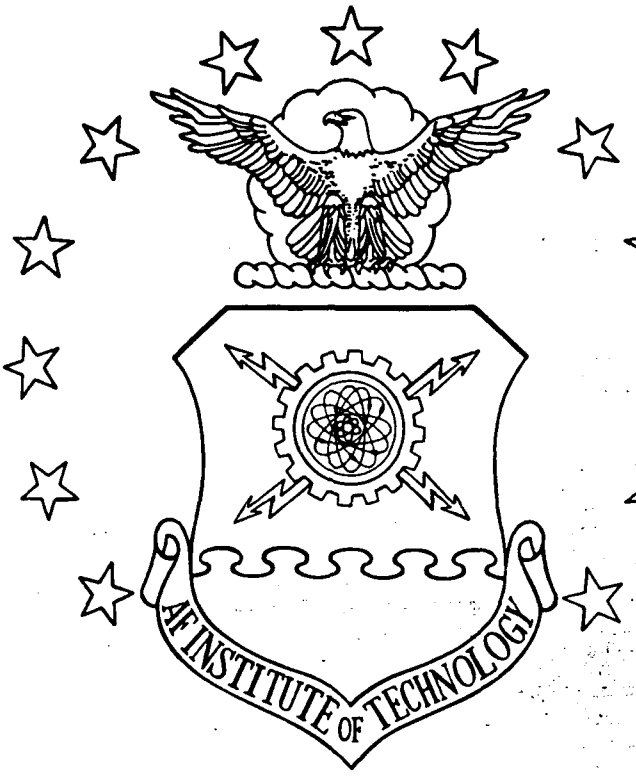

A COMPARISON OF MICROCOMPUTER TRAINING METHODS AND SOURCES

THESIS

David M. Kondas
Captain, USAF

AFIT/GCA/LSQ/89S-7

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GCA/LSQ/89S-7

A COMPARISON OF MICROCOMPUTER TRAINING METHODS AND SOURCES

THESIS

David M. Kondas
Captain, USAF

AFIT/GCA/LSQ/89S-7

Approved for public release; distribution unlimited

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information is contained therein. Furthermore, the views expressed in the document are those of the author and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

AFIT/GCA/LSQ/89S-7

A COMPARISON OF MICROCOMPUTER TRAINING METHODS AND SOURCES

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Cost Analysis

David M. Kondas, B.S.

Captain, USAF

September 1989

Preface

The purpose of this study was to evaluate the methods and sources of microcomputer training currently used in the Air Force. I hope my findings and further studies can provide government managers with the information they need to choose the most cost-effective training for employees.

I surveyed a sample of 151 people from the 19,000 who work in AFLC and ASD on Wright-Patterson AFB to compare levels of training effectiveness, employee computer competence, and training value to government employees which result from three methods of PC training: classroom, video-based, and computer-based (CBT). I wanted to evaluate three sources of such training: in-house, contractor, and private (e.g. university, college). I believe this study can be used as the framework for additional studies which could provide better evidence for which training methods should be used and which should be avoided in the future.

Thank-you to the people who assisted me in this research: The folks at HQ, Air Force Logistics Command; Aeronautical Systems Division; and the USAF Small Computer Office Automation Service Center. A big thanks to Professor Jeff Daneman, my thesis advisor. I also want to thank my friends Greg Allen and Cheryl Duckett for their support. I especially want to thank my wife, Judy for her patience, understanding, encouragement, and love.

Mike Kondas

Table of Contents

List of Tables

Abstract

The purpose of this study was to evaluate the methods and sources of microcomputer training currently used in the Air Force in terms of their overall value to the job, training effectiveness, and level of competency achieved upon completion. The three methods studied were classroom instruction, video-based training, and computer-based training (CBT). The three sources studied were in-house training functions, government-contracted training, and private (i.e., colleges and universities).

One hundred and fifty-one government employees rated each method and source of PC training they had experienced. These ratings were used to produce a ranking which can be found in chapter V.

Classroom training was found to be the most often used and the most popular method of PC training, regardless of source. The preference of delivery method was classroom, CBT, then video-based training, regardless of source.

A cost-benefit analysis was performed to compare the two most often used sources of classroom training: in-house and government-contractor. Statistical results indicated that the two sources are equal in terms of the benefits stated above. Cost-per-training hour was slightly lower for vendor-provided training than for in-house training. Resources required to establish and maintain in-house

training functions were substantially greater than those required to support vendor-provided training programs.

The study found that college or university PC training was rated equally with in-house and commercial sources regardless of method.

One particular recommendation, in light of the challenge presented to managers for improving microcomputer training in the workplace, is to investigate the possibility of training government employees by contract with local educational institutions. Potential benefits include better trained and educated employees, higher morale, and savings of operations and maintenance funds. Savings of O&M funds are possible in two ways. The first is that employees could use tuition assistance funding since such training also meets individual educational needs. The second is that such training, if attended in off-duty hours, could mean higher levels of productivity. Again, these possibilities, although promising, require further investigation.

A COMPARISON OF MICROCOMPUTER TRAINING METHODS AND SOURCES

I. Introduction

General Issue

The introduction of microcomputers (also known as personal computers, desktops, PCs, and micros) into the Air Force work environment created an exceptional potential for increases in productivity. But the full productivity benefits of microcomputers have yet to be realized in the Air Force due to lack of accurate information for decision-making about which method of training to choose for employees who are end-users of microcomputers (19; 28; 10).

U. S. Air Force investment in microcomputers will represent a large portion of the nearly 400 billion dollars projected to be spent on microcomputers in America by 1990 (8:17). The plan for a computer on every USAF desktop is approaching fruition (10). In light of this success however, managers are faced with the challenge of ensuring that *every* PC is used to the maximum extent possible to increase productivity rather than collect dust. To do so, they must find the most effective training for their employees at the lowest possible cost.

A review of current literature revealed that no studies have been published within the Department of Defense or USAF which address the impacts in the workplace of various microcomputer training methods . Succinctly, no studies were found which address microcomputer training effectiveness, the resulting employee computer competency level, or the overall value of such training to the employee within the DOD or USAF. Furthermore, little data exists to identify which methods make employees more productive, or equally important, which methods are the most cost-effective. If more complete and accurate information were available, decision makers could be more successful at choosing more cost-effective methods microcomputer training methods.

Background

The Air Force, it its initial efforts to establish microcomputer training, followed the traditional pattern for meeting military training needs. Air Training Command (ATC) established the Small Computer Training branch at Keesler Air Force Base, Mississippi in March 1984 (19). The Air Force Communications Command (AFCC) introduced initiatives to develop small computer support focal points at bases worldwide during the mid-1980s (28). These focal points are now called Small Computer Customer Centers. Success of

these support efforts, which is discussed in more detail in chapter II, has been mixed. (19; 28)

Part of the problem stems from the fact that management had failed to recognize the need to address end-user training in the early stages of microcomputer growth in the DOD (18:2). Arthur Young & Company performed a study for the Office of the Assistant Secretary of Defense (Comptroller) as part of a project designed to identify management issues and concerns and recommend alternatives for a comprehensive approach to managing the growth in computer technology. The 1983 report, containing the findings for that portion of a project which dealt with user support, mentioned training once - one word, one sentence. (6)

Some efforts were made to identify the need for PC training, but these efforts were limited and have proven to be less than successful. (28; 10; 29) The 1984 Air Force Management Analysis Group on Data Systems Management and Manpower Impacts recommended that, "a major campaign should be conducted to improve the computer literacy of Air Force personnel" (18:17-8). One reason that such a campaign has not been successfully undertaken is the perennial problem of a lack of proper information for decision making - the subject of this thesis (10).

Specific Problem

The specific problem which this thesis addresses is that faced by Air Force managers of microcomputers and the employees who use them:

> Which microcomputer training methods result in the highest levels of training effectiveness, computer competency, and value to the employee per dollar spent?

Particular Approach

To find a solution to the specific problem, the particular approach used in this thesis included a review of the progress made thus far in meeting microcomputer training needs in the Air Force; a review of currently available training methods; interviews of selected Air Force personnel involved in decision- and policy-making for microcomputer training; a survey of USAF employees who have received microcomputer training; and the application of a cost-benefit analysis of the two most prevalent microcomputer training methods currently used by the Air Force.

Existing literature about various microcomputer training methods used by other modern organizations was reviewed. Additionally, selected Air Force personnel involved in microcomputer training issues and policy making were interviewed to determine what the Air Force has recently done, or is planning to do to meet the changing needs in microcomputer training. These individuals were assigned to the staffs of Air Training Command, Air Force

Communications Command, Air Force Logistics Command, the Department of Defense Small Computer Office Automation Service Activity at Gunter AFB, Alabama, and the Aeronautical Systems Division.

A literature review indicated that many private sector organizations employ cost-benefit analyses to decide which training sources and methods to use for their employees. This thesis includes such an analysis of two particular sources of the classroom method of training used by the Air Force, in-house and commercial. Two other methods of PC training - computer-based and video-based - and one other source of training - colleges and universities - are also evaluated, but only with regards to benefits since cost data was not available for this research.

To determine the benefits of each method, a questionnaire-survey was administered to government employees who received one or more types of microcomputer training in the past three years. This survey was used to collect data on levels of microcomputer training effectiveness, employee computer competency, and overall value to government employees.

Scope

Training Sources. There are a number of sources form which the Air Force can currently obtain PC training. Time constraints and lack of objective data for all sources and

methods of training consequently limited this study to threeo sources: in-house, vendor-provided, and college or university, referred to as private training. In-house training is defined as that training given to government employees using government facilities and instructors. Vendor-provided training is defined as that training given to government employees using non-government facilities and, or instructors.

The cost-benefit analysis herein addresses only in-house and commercial sources. However, some preliminary findings concerning private sources of PC training are also presented. The primary method used as a basis for comparison of in-house and commercial sources was classroom instruction. This particular method was chosen over others since it represents the largest investment of training dollars and hours (10) and substantial data sources for each source were readily available within the same geographical region, i.e., the area surrounding Wright-Patterson Air Force Base, Ohio.

Models Used. For purposes of this thesis, two real-life models were used for data collection and research. The government-operated training facility located in building 110 on Wright-Patterson AFB, Ohio serves as the model for in-house training provided to government employees working primarily in Air Force Logistics Command organizations. The real-life model for vendor-provided training is the

Aeronautical Systems Division (ASD) of Air Force Logistics Command. ASD receives over 99% of its training from public contractors located in the area surrounding Wright-Patterson AFB (17). These companies include J and K Associates of Dayton, VALCOM Training Center also of Dayton, and Logistics Systems Architects (LSA), located in Fairborn, Ohio. J and K Associates and VALCOM provide almost fifty percent each of the training provided to ASD (17). LSA, which currently handles only a small percentage of training for ASD, also has offices near the Air Logistics Centers at Midwest City, Oklahoma, Sacramento, California, and Warner Robins, Georgia (7).

Costs. The author has made every attempt to capture all costs *associated with each of the two types* of training. In cases where costs would be the same for either source, e.g., employee time away from normal duties, costs are not reflected.

Benefits. The level and types of benefits which accrue from the many types of microcomputer training were numerous. Three particular types of benefits are frequently used as the basis for private sector source/method selection, and were chosen as most important from an Air Force manager's perspective. The first of the three is microcomputer training effectiveness which was measured by how much material a student can learn in one hour of training. A ratio of the level of material learned to the cost of one

hour of such training can be computed which facilitates the comparison of one method to another. The second benefit used is employee computer competence - as measured by the level of computer competence achieved as a result of the *type* of training taken rather than the course material. Here, a ratio, based on a percentage of material mastered, can be used to compare methods. Finally, the last measure surveyed is the level of overall value to the government employee. This particular benefit was chosen since, frequently, training methods do not focus on the training needed in the employee's duties, but rather provide a generic overall exposure of material (14:25). In such cases, training costs could be considered wasted since learned material can be forgotten as a result of non-use (14:25; 20:40).

Summary

This chapter has introduced the general issue, microcomputer training methods, and provided a brief background which highlights an overall problem in the inability of current USAF computer training programs to meet *all* current training requirements. In light of this shortcoming, the specific problem to be addressed by this thesis is which sources are most cost-effective when compared in terms of three benefits achieved through classroom instruction. The three benefits are training

effectiveness, computer competency, and overall value to the government employee and will serve as a basis for comparison for the two most prevalent sources currently used in the Air Force - In-house and Vendor-provided.

II. Literature Review

Introduction

This chapter will address several topics associated with the management of microcomputers in modern organizations while focusing on the progress made thus far in the Air Force. Using a model for the life cycle of computers in organizations, a discussion of the importance of planning for microcomputers is presented. A primary element addressed in such planning - training - is covered next. The remainder of the chapter is devoted to a discussion of each of the more popular methods of microcomputer training currently available with a focus on in-house and vendor-provided classroom training.

Managing Computers in Modern Organizations

Successful management of automation in today's organizations requires effective integration of computers into the workplace. (23:324; 25:121). One survey of management information system experts ranked this management challenge as their "second most important...for the 1980's" (15:353). Two major management responsibilities in integration are planning and training (25:121).

The Importance of Planning

Planning for microcomputers is a necessary management process. In his book entitled, "Microcomputers in Large

Organizations," Thomas Madron explains the planning process:

> The planning process implies that several things have happened in the organization. First, planning necessitates a clear understanding of the problems involved. Second, it requires that some institutional policies and goals be established.... And third, it involves the elaboration of appropriate procedures for implementing the policies and solving the problems. (25:116)

Madron states, "proper planning...is *essential* for micros to be used well" (25:vii).

Managers are beginning to recognize the significance of proper strategic planning. In a 1985 survey of management information system managers, Dr. Curt Hartog, Assistant Director of the Center for the Study of Data Processing at Washington University, St. Louis, Missouri, found that long range planning was the highest rated issue of concern. (15:352)

The Nolan Stage Model. A model can be used to illuminate the significance of planning during the life cycle of computers in an organization. The Nolan Stage Model, developed by Cyrus F. Gibson and Richard L. Nolan, identifies four distinct stages of the evolution of information system activities and their related problems within organizations. The four stages of this model are: Initiation, Expansion, Formalization, and Maturity. (9)

Stage 1, Initiation, involves the initial acquisition of computers. In his thesis on "End User Software Development for Transportation Applications," Caver describes the

typical situation faced by modern organizations when implementing microcomputers:

> At this stage long term implications are rarely considered by management, and there is little strategic planning for other impacts of the computer on personnel, or the organization. (2:14)

Stage 2, Expansion, is described by Caver as the "...rapid and uncontrolled growth in the use and acquisition of computer systems" (2:14). This chaotic growth, combined with a lack of adequate management involvement, results in rapid cost increases which are not planned for before computers are acquired. (2:14; 9:80-83; 16:10-11)

Stage 3, Formalization, begins with management's attempts to gain some control over the disorder of the Expansion stage. Control becomes centralized as formal planning, standardization, and integration begin. (2:14; 9:83-86; 16:11-12)

In Stage 4, Maturity, management regains control. Computer policy becomes integrated with overall corporate policies and computers are ultimately managed as effectively as all other resources. (2:15; 9:86-88; 16:12)

Experts agree that most companies are still in the Initiation or Expansion stages of this model. As such, planning in these organizations is lacking. (9; 16)

Planning In the Air Force. Caver implies that the Air Force is in stage 2 or 3, along with many of its civilian counterparts, by stating, "...the Air Force has focused the

majority of its attention on obtaining microcomputer hardware and software..." (2:23). There is evidence that the Air Force does have some work to do (to reach Stage 4, Maturity) in managing microcomputers as effectively as all other resources since training needs are not being met entirely. As mentioned earlier in chapter I, the 1984 Air Force Management Analysis Group on Data Systems Management and Manpower Impacts recommended that, "a major campaign should be conducted to improve the computer literacy of Air Force personnel." (18:17-8) The efforts that resulted from this recommendation are discussed later in this chapter under Training in the Air Force.

Planning Outside the Air Force. The Air Force's lack of successful planning is not atypical. Management experts at Case Western Reserve University in Cleveland, Ohio, performed a survey of 173 Forbes 500 companies which use personal computers and found that:

> ...many problems appear to be related to the lack of clear policies on the part of top management... greater attention is needed to...techniques of strategic planning for personal computing. (12:184)

The researchers indicated, "the most critical problem...is lack of...long-term perspective..." (12:182). The lack of adequate planning in the management of computers can lead to a multitude of other problems; one of the more serious problems is the lack of proper training. (12; 2; 25; 24; 23)

The Need for Training

While *managers* find that lack of planning is the most serious computer management problem today, *employees* indicate that lack of training is a much more significant problem (23:324). A 1985 study about sources of assistance for end users of microcomputers in the private sector revealed basic trends occurring among employees using microcomputers. The study revealed that the lack of formal training caused less than effective use of computers. The study also found that the most popular source for computer assistance when formal training wasn't available was coworkers. The next best source of information was the in-house information systems staff; use of this source, however, was less than expected. (23:324) The next section will demonstrate how similar trends have also occurred in the USAF.

Training in the Air Force. Air Training Command established the Small Computer Training branch at Keesler Air Force Base, Mississippi in March 1984 as a first step to provide microcomputer training to end-users in the Air Force. The branch offers in-house training and supports a mobile team which travels to Air Force bases throughout the world. Nine instructors must staff the resident course at Keesler and travel up to 350 days a year to train as many as 9500 students per year. (19)

The team chief, MSgt Justin Johns, indicates that the demand for training is growing but not being met through Air Force resources:

> Up to 35,000 people need training right now. Some bases are paying contractors up to $1000 a day because they can't wait for us. We just don't have the money or manpower. (19)

Other organizations have sought to fill the training gaps that ATC resources cannot meet. Air Force Communications Command introduced small computer support focal points at bases worldwide during the mid-1980s, now called Small Computer Customer Centers. But these centers are limited in the level of support they can offer. (19; 28)

Essentially, these centers provide a microcomputer consulting service upon request. One reason for their limited success is that users don't necessarily possess enough basic knowledge of computers to know what to types of service or training to request. According to Captain Albert Olague, Chief of Computer Requirements for AFCC, "Many users don't have sufficient computer knowledge to know what questions to ask: that's definitely a training problem" (28).

Captain Olague and MSgt Johns both agree that these problems have reduced the level of productivity expected from microcomputers in the Air Force (19; 28). MSgt Johns has traveled to Air Force bases worldwide for over four years to train microcomputer users. He estimates that as

many as one in seven micros are not used due to the lack of proper training (19). As micros appear daily on Air Force bases around the world, the demand for training is frequently filled by Air Force employees working with each other or forming base level computer groups. This form of training usually takes more time, is less effective than formal training, and in some cases results in actual productivity decreases. (19; 28).

These problems apparently did not go unnoticed. As mentioned earlier in chapter I, the 1984 Air Force Management Analysis Group on Data Systems Management and Manpower Impacts recommended that, "a major campaign should be conducted to improve the computer literacy of Air Force personnel." (18:17-8)

Not until recently has such a campaign been pursued on any large scale. In 1988, the staffs of the Air Force Communications Command at Scott AFB, Illinois and the Air Force Small Computer Office Automation Service at Gunter AFB, Alabama (AFSCOAS) began efforts to develop a means of ensuring that microcomputer training would be available when and where needed throughout the USAF. Since current hardware and software acquisition contracts frequently do not include provisions for other than limited orientation training, AFCC began considering a "Training Only" contract; negotiated as a tri-service contract to realize greater volume savings. Before any significant results were

achieved, the Air Staff turned over the major portion of responsibility for small computer training issues to AFSCOAS during the winter of 1988. (28; 10)

Coincidentally, the AFSCOAS was in the process of awarding a new multi-user system contract and writing a new Desktop contract. Both of these contracts cover a variety of small computers, associated software, system support, and for the first time, more formalized training (28). Both the AFCC and AFSCOAS staffs expressed concern over the fact that users who were not covered by these two new contracts would not be guaranteed training when and where it was needed (28; 10).

Since such gaps still exist in meeting the training needs of end-users, bases are looking for new ways to meet the expanding PC training requirements. Recent efforts at more than a few bases have resulted in some rather innovative approaches to training employees who use PCs. For example, according to the AFSCOAS, a number of bases are working with local community colleges to provide training to base employees. Among the results are lower costs, improved community relations, and very satisfied employees (who receive quality training *and* college credit). (10)

A number of bases are filling the training gap by establishing their own in-house training facilities or by contracting with local vendors for PC training. Examples of each of these training methods are the programs designed to

meet the training needs of micro users at Wright-Patterson AFB Ohio.

The Air Force Logistics Command (AFLC) has created its own in-house formal training facility. The facility, located in building 110 in Area A on Wright-Patterson AFB, is officially referred to as the Communications-Computer Systems Training Facility for Headquarters, Air Force Logistics Command (29).

The Aeronautical Systems Division (ASD) of Air Force Systems Command (AFSC) satisfies over 99 percent of its computer training needs by contracting with local companies which specialize in such training. J and K Associates of Dayton provides nearly 50 percent of the training given to ASD employees. VALCON Training Center of Dayton also handles almost another 50 percent of ASD training requirements. Logistics Systems Architects, located in Fairborn, Ohio, currently provides the remaining portion of ASD microcomputer training. Approximately 35 to 40 percent of the training courses are taught at the vendors' facilities located off-base. The remainder of the class are taught in classrooms located within ASD facilities in building 16. A number of other organizations on Wright-Patterson AFB also contract with these companies. (17) Such programs can be found on more and more bases as managers work to meet training requirements (11).

Training Outside the Air Force. The private sector has experienced similar trends. Reaction is slow, but managers are beginning to recognize the problems. The Forbes 500 survey mentioned earlier covered a five year span 1980 through 1984. Of the 173 companies surveyed, only 49 percent had implemented training programs before 1984. In 1984, however, the number of companies offering training to end users increased to 72 percent. (12:183).

Experts continue to emphasize that training programs are not keeping pace with acquisition programs, in or out of the Air Force (23:324; 25:124; 2:24; 19; 28). Inadequate training continues to be a primary cause of less than potential increases in productivity expected from micros (23:312,324; 19; 28). In her study of microcomputer usage patterns, Denis M. S. Lee of the Worcester Polytechnic Institute in Massachusetts, cited a study which estimated, "that between 20% to 36% of microcomputers end up abandoned by users." Again, management attention was cited as the first step towards solution of such problems. (23:313,324) At least one area requiring management attention is the proper selection of training methods. The next section presents a discussion of such alternatives for Air Force managers.

Training Methods - A Matrix

Although a number of methods have been developed to train microcomputer users, a few have emerged as the most popular for training- and cost-effectiveness. These methods can be classified by a matrix of orientations, modes, and sources (20; 8; 21).

Orientations of Training

The three orientations refer to the content of the material taught: Computer literacy training; Product-oriented training; and Business-oriented computer training. (20:39-41)

Computer Literacy Training. Computer literacy training is aimed at the basics of operating a PC such as turning the machine on and off, loading the software, and understanding basic operations of spreadsheet and database functions. (20:39)

Product-oriented Training. Product-oriented training covers operations of individual software packages such as how to find the mean of a column of values in Quattro, a spreadsheet application. (20:39-40)

Business-oriented Training. Business-oriented training is designed to teach the student how to apply the power of a computer to his or her primary work situations. One example of such training might be how to use spreadsheets to historically track supply issues and forecast future demand

levels for particular products. This particular orientation is growing in popularity as it becomes more refined. (20:40-41)

Modes of Training

The mode of training refers to the medium through which course material is presented to the student. There are five basic modes of PC training used today: Instructor-led; Audio cassette; Video; Computer-based; and Interactive video. (8:17-21)

Instructor-led Training. Instructor-led training, also known as classroom training, is the most traditional of the five modes of training. A major advantage of this mode of training is the availability of immediate feedback for students. Another advantage is the ease of tailoring the course to meet student needs. (8:18)

One of the disadvantages of this mode is the slower pace required to meet varying skill levels. Another drawback is the additional time required since courses frequently cannot be broken into manageable segments as with other methods; most courses are based on two to three day schedules. If held in the workplace, instructor-led training can be convenient and avoids travel costs for students. But on site training also means that PCs won't be available for job-specific output. (8:18)

The costs for instructor-led training are typically higher than for other modes. For example, an off-site course offered by the American Management Association costs more than $800 per person for non-members. Although this mode is generally more expensive than the other four, it is offered by more vendors than other modes; an indication of its persistent popularity. (8:18)

Audio Cassette Training. Audio cassette training is among the lowest cost modes available; as much as one tenth the cost of video training. Essentially, this mode requires the user to listen to taped instructions while seated at the computer. A manual is usually provided for further reference. (8:19)

A major advantage of this mode is that it is self-paced and can be broken into manageable segments to fit a variety of schedules. Although answers to specific questions or other forms of feedback from an instructor aren't available with this mode, if needed, the student can review any particular topic as often as needed. Another advantage is the lack of a requirement for specialized equipment - only a PC and a cassette player are needed. (8:19)

Costs in 1987 for audio cassette training ranged from approximately $125 to $700 per course. One course, however, can be used to train many people. (8:19)

Video Training. Video training offers a wide selection of sources and subject matter. One company, Advanced

Systems, Inc. (ASI) based in Chicago, offers over 3500 video training modules on almost every PC-related topic from tapes of instructor-led classes to tapes on the latest developments in computers. (8:19-20)

Among its advantages, video training offers convenience, speed, and a source for future reference. Some video courses include manuals, demonstration disks, and templates for users' keyboards to help them locate frequently used keys. It is similar to audio cassette training in that the student can train when s/he wants to and can review a topic whenever necessary, but instructor feedback isn't available. (8:20)

Of course, this mode requires an investment in video tape equipment. The costs for video training can vary from $500 to $700 per package; but again, one package can be used for a number of students. (8:20)

Computer-based Training. Computer-based training, also known as CBT, is beginning to climb in popularity for its cost-effectiveness and user-friendliness (8:20). CBT involves the use of a software package which instructs the student via a variety of textual and graphic displays and then tests him/her on the material covered - all on the screen of the user's PC (32). More sophisticated CBT packages can analyze the student's responses and tailor a combination of feedback and lesson review to enhance the

student's understanding (32). As in audio and video training modes, human feedback is not available (32).

The costs for CBT packages vary widely; but experts and managers agree that it has proven to be a cost-effective means of training a large number of users in a relatively short time (8; 32). Experts also agree, however, that an effective evaluation of whether CBT meets the needs of the organization effectively in relation to the costs involved should be carefully undertaken - CBT is not for everyone (26:32-35).

Interactive Video Instruction. Interactive video instruction (IVI) is the most recently developed mode of training for PC users. This mode uses the computer and a laser videodisk to communicate with the student through the keyboard and, or touches the screen to respond. (8:21)

The user can ask and answer questions, determine what to cover next, and move on to or review subjects covered in the training lesson; IVI is self-paced and self-directed. Research shows that users' fascination with the ingenuity of this mode of training results in faster learning, greater retention, and greater competency than with other modes. (8:21)

A major disadvantage of this mode is the initial investment in required hardware: $10,000 for a workstation, video-disk player, and touchscreen monitor. In the future, video course material may be stored digitally on a central

computer for use at a number of remote terminals which should reduce costs. ASI, the company mentioned earlier, offers this mode of training by installing the hardware for its customers and leasing the software; the cost in 1987 was approximately $100 per month. (8:21)

Sources of Training

There are three sources of microcomputer training available to managers today: Hardware/Software Vendors; Consultants; and In-House specialists (21:50). Some experts group hardware/software vendor and consultant training into one category - vendor-supplied training (20:41). Although discussed separately in detail in this section, for purposes of clarification, the use of Vendor-provided training elsewhere in this thesis refers to both hardware/software vendors and consultants. The term, "vendor-provided" is used by ATC, AFCC, and AFSCOAS to refer to training provided by either the initial hardware/software vendor *or* a third party consultant including, in some cases, local colleges or universities.

Hardware/Software Vendors. This source is usually the least costly of the three; frequently free with the purchase of equipment and, or software (21:50). Training received is generally on an initial familiarization basis and includes little or no follow-up without additional charges (11).

Initial training most often includes a brief orientation by a technician supplemented with self-paced packages of manuals, tutorial disks, and, or video tapes. Such training can be offered at the vendor's place of business or on site. (21:50)

A major drawback to this source of training is the lack of feedback from an instructor or knowledgeable person once the training has been completed. Also, users can spend a great deal of time looking for the answers in manuals or on disks or tapes, thus wasting valuable work time. And such answers may not always by the best solution to the problem. (21:50)

Customer training is being recognized by vendors, however, as growing in importance to their ability to sell their product (30:85-6). Fifty-eight percent of the vendors surveyed by Work System Associates, Inc., in Framingham, MA, indicated that customer training was, "...either essential (could not sell the product without it) or very important..." (30:86)

Although the costs are usually much lower for this source of training, its limitations are often the reasons organizations turn to other sources of training. (21:50-51)

Consultants. Third party consulting has evolved into a fast-growing industry (30:84). The major advantage to this source of microcomputer training, which typically involves off-site classroom training, is the lack of necessity to use

in-house resources. This advantage should be considered carefully and compared to the costs of such training which can be significantly higher than other sources. (10:50; 8:18). Also, unless recorded in some useful manner, the material covered cannot be accessed for future reference (21:50).

Some consulting companies are responding to this lack of reference by providing materials which students can take back to the workplace (7; 17). The companies providing training to ASD, for example, provide manuals which are written so users can find answers quicker and understand them easier than with the original manuals provided by hardware or software companies (17; 7).

In-House Training. Larger organizations often find that the development of an in-house training function is more cost-effective and easier to tailor training to specific organizational needs. In-house training is very often less expensive than training provided by consultants. It can also offer more flexibility and reliability in scheduling than outside training sources. (21:50; 20:41)

The potential disadvantages of this source of training are the requirements placed on the organization's resources - time, personnel, and money. Separate facilities, additional personnel, and separate equipment are required for in-house training. (21:50; 20:41)

These disadvantages could be considered important only in the short run. If the training of employees is considered an investment in increased productivity, and the return on the investment is carefully calculated, the disadvantages can be outweighed. This assumes, of course, that the in-house training function is managed effectively. (21:50; 20:41)

All of these sources of training will soon be able to offer any of the five modes geared to any of the three orientations discussed above. Customer demands will require and technology will make possible an increased number of alternatives for managers to consider in meeting their employee's training needs. (30; 21; 20; 32)

Summary

The rapid growth in microcomputer hardware in the Air Force presents significant problems to Air Force management. This chapter discussed the importance of proper planning for the growth of microcomputers and adequately addressing subsequent training requirements. A main point should be stressed here - more and better formal training programs are needed and should be focused more towards the end users of microcomputers.

With this focus in mind, the results of efforts by both the Air Force and private sector organizations to meet PC training needs were discussed. Managers of all modern

organizations which utilize microcomputers acknowledge the need to *further* improve the training offered to their end-user employees.

Also discussed were the orientations, modes, and sources of training currently available to modern organizations were presented and analyzed. These elements form a training matrix from which the manager is able to choose the content, the method, and the source of microcomputer training. Such a matrix permits the manager to tailor training to the users' as well as the organization's needs (8; 20).

Business-oriented training, which teaches employees to use microcomputers to solve real world problems, is growing as users move upward from basic skills training to software mastery training. While instructor-led classroom training maintains a foothold in the computer training industry, more innovative modes (or methods) of training, such as computer-based training (CBT) and interactive video instruction (IVI) are gaining in popularity as they become more effective in terms of training results and costs.

Since consultant training usually means high costs, companies which sell hardware and software are offering improved training as a *discriminator* when competing for organizations' business. But larger organizations, including the Air Force, are finding that establishing in-house training can mean lower costs for training which can

be tailored to fit their needs. Some bases are taking more innovative approaches by exploring the use of local colleges or universities as sources of PC training; the potential benefits of such programs are unique.

The next chapter will present the methodology used in this thesis to evaluate two sources and methods of government microcomputer training. Again, the focus of the thesis is on two primary sources - in-house and vendor-provided, and one primary method - classroom. As mentioned earlier, vendor-provided training refers to training provided to government employees through a contract. A vendor may be a hardware or software vendor or a third party consultant. In this thesis, the vendor is a third party consultant. Chapter III will also present how data will be evaluated for a third source of PC training - colleges and universities, as well as the three methods of PC training - classroom, CBT, and video-based.

III. Methodology

Introduction

This chapter will discuss the methodology used to evaluate sources and methods of microcomputer training for government employees. The objectives of this thesis are presented first. The steps taken to perform the cost benefit analysis are discussed next. This is followed by a discussion of the content and structure of the survey used to collect benefit data. The last sections of this chapter cover how survey responses were treated and the responses which were expected from the survey for each benefit.

Objectives

The primary objective of this thesis was to compare the two primary sources of government microcomputer training, in-house and commercial. The comparison focused on the most prevalent method of PC training used in the Air Force, classroom instruction. A cost analysis identified costs associated with each source. Benefits and costs were used to compute benefit-per-dollar-spent ratios for each source of training.

A secondary objective of the thesis was to rank each particular method/source combination according to the level of benefits achieved. As mentioned in chapter II, any orientation or mode (method) of training may be available from any particular source of PC training. Data on private

sources as well as the other two methods of PC training was also collected and analyzed. A survey-questionnaire of government employees was used to collect the data which represent the benefits of each of three methods: classroom, video, and CBT. The responses from the survey were averaged according to source and method and used to rank each combination.

Cost Benefit Analysis

The primary instrument used to evaluate in-house and commercial sources of classroom training was a cost benefit analysis. Direct and applicable indirect costs for each source of training were computed to derive a cost-per-training hour. The *benefits* used in the analysis were measured by a survey of government employees on Wright-Patterson AFB, Ohio. Benefit-to-cost ratios were used to used evaluate the two sources.

Cost Analysis. All costs which are identical to both sources were excluded from the cost analysis. For example, time away from primary duties is not reflected in the costs of either source.

Costs for the in-house source were provided by HQ AFLC personnel responsible for government accounting system records. Examples of these costs include supplies, utilities, personnel, travel, and facilities maintenance costs.

Direct costs for the training contracts were provided by ASD personnel responsible for managing the contracts. Indirect costs were also provided by ASD personnel who maintain government accounting system records.

Benefit Analysis. Levels of benefits for both sources and all methods offered were estimated by using data gathered in a survey of government employees working on Wright-Patterson AFB, Ohio. The next section discusses how responses were converted to represent levels of three benefits: overall value to the employee, training effectiveness, and level of competence achieved as results of various methods and sources of microcomputer training.

Survey

Appendix A is a copy of the survey given to 540 government employees of Wright-Patterson AFB, Ohio. One-half of the 540 surveys were sent to employees who had taken at least one microcomputer training course at the Air Force Logistics Command in-house training facility in building 110 of area C. The other 270 surveys were sent to employees who had taken at least one course offered by vendors in the Dayton area, the primary source for microcomputer training for the Aeronautical Systems Division (ASD) of Air Force Systems Command (17). The survey was approved by the Air Force Military Personnel Center which assigned USAF SCN 89-59 (survey control number).

Sample Size. The author chose the sample size of 540 to measure a population of approximately 19000 employees. Based on discussions with officials at the base civilian personnel office, the historically expected response rate was 25%, i.e., 135 surveys were expected to be returned (7). A sample of 135 from the population of 19000 would produce results with a confidence interval of 90% and an error rate of ±10%.

Survey Structure. The survey is composed of three questions which ask the respondent to assign a value between 0 and 100, in increments of 10, to each of nine elements per question. The respondent is asked to assume that 100 represents the ideal level of the particular benefit being addressed. This structure is designed to *force* the respondent to compare all methods of training simultaneously for the same benefit. The following structure was used for all three questions:

IN-HOUSE (officially provided by government employees):
___ a. Classroom training (traditional student-instructor)
___ b. Video-based training (typically requires students to observe a video tape rather than a human instructor)
___ c. Computer-based training (computer software "instructs" and prompts student for input)

COMMERCIAL (through use of government contract):
___ d. Classroom training (traditional student-instructor)
___ e. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ f. Computer-based training (computer software "instructs" and prompts student for input)

PRIVATE (through your own efforts or off-duty):

___ g. Classroom training (high school, college, university)

___ h. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ i. Computer-based training (computer software "instructs" and prompts student for input)

The use of the word commercial in the survey refers to training provided through a government contract. The third source, private, was added to measure how employees rate off-duty training. Such information could be used to study the possibility of expanding support of off-duty microcomputer-related training. Chapter II. mentioned that this particular avenue is being explored by other bases which are located near under-graduate or graduate educational institutions.

Expected Responses. The following sections include the expected responses for each method and source of training addressed by the survey. To develop data for the benefit measured, responses for each item were averaged.

The means of each response were tested for statistical significance. The Standard Normal Random Variable, or Z-test were performed under the assumption that the data were collected from normally distributed populations. A statistical significance level of five percent was used for the two-tailed test to compare means ratings for each

method/source combination. The Mann-Whitney test is a non-parametric test which does not require the assumption of normally distributed data. The Mann-Whitney test was performed only to verify differences (also at the five percent level) in means for in-house, vendor-provided, and private source classroom training. These tests were performed to determine if the average responses for each method/source combination were significantly different, statistically speaking. Test formulas and guidelines can be found in the reference cited in the bibliography (27). The Mann-Whitney ranked sums were produced using a generic statistical computer program.

Value of Training to the Employee. Question 1. asks the employee to identify and evaluate each type of training the employee has taken. This question essentially measures employee satisfaction as a result of the method of training used. Question 1.:

> 1. This question is designed to do two things: a) determine which types of training you have completed; and b) how you would rate the types of training you have received in terms of overall value to you as a government employee. By overall value, we mean the degree to which the training made you more productive, versatile, and, or effective in your job. Remember, 100 represents the ideal level of value to you as an employee. Assign a number only to those types of training you have completed (even if you've only had one).

The expected number of responses for classroom training from all three sources, in-house, commercial, and private, was expected to exceed 60% for all responses. Based on the popularity of classroom training, the percentages for all three sources of classroom training were also expected to be high, i.e., above 70 percent. The order of value by source was expected to be in-house, commercial, and private.

The least popular method was expected to be video-based training. The expected order of value by source was commercial, private, and in-house. Responses for these items were expected to be below 30%. The number of employees who have taken such training was expected to comprise less than 25% of the sample.

The remaining items associated with CBT were expected to receive responses of between 30% and 60%. The number of employees who have taken CBT training was expected to be only slightly higher than the number who have taken video-based training. The order of value by source was expected to be commercial, in-house, private.

Training Effectiveness. Question 2. asks the employee to determine the amount of material the employee effectively learned per hour of training as a result of the method and source of training rather than the material content of the course. Question 2.:

2. This question asks you to determine how much you can effectively learn from a course as a result of the type of training used. Assume that 100 represents the most material you could effectively learn in one hour of training. For each of the types of training you have taken, assign a number which represents the amount of material you feel can be learned for ***each hour*** of training.

The highest responses were expected to again be for classroom training from, in order of effectiveness, in-house, commercial, and private. Responses for this method were expected to be between 70% and 100%.

Video-based training responses were expected to be between 50% and 90%. Although no specific order was expected, video-based training from a commercial source was expected to receive the greatest number of responses among the three sources.

Responses between 10% and 60% were expected for computer-based training. In-house was expected to receive the most responses and private, the least among sources for this method of training.

Employee Competence. Question 3. asks the employee to determine his/her level of competence as a result of the method and source of training taken. Question 3.:

3. This question asks you to determine your level of competence upon completion of each type of training you received. For example, if you took a course, but felt you could only master 60% of the course material *because of the type of training used*, assign a 60.

Again, classroom training was expected to receive the highest responses ranging from 70% to 100%. The expected order by source was in-house, commercial, and private.

Computer-based training was expected to receive the second highest responses ranging from 60% to 80%. The expected order was the same as for classroom training: in-house, commercial, and private.

The average expected response for the level of competence achieved through video-based training was 50%. Although, no particular order was expected, private and commercial video-based training were expected to be rated higher than in-house video-based training.

The next chapter presents the findings of this particular research effort.

IV. Findings

Introduction

The chapter will present the findings of the cost and benefit analyses performed to evaluate which sources of PC training are most cost-effective for the Air Force. Survey response is discussed first, followed by an analysis of employee training experience. An evaluation of the ratings data for benefits of each source and method of training is discussed next.

Each benefit is discussed in terms of the averages of all ratings for each particular method, and the number of employees selecting one method over another. Appendix B contains spreadsheet printouts of the ratings.

The first benefit discussed is overall value to the government employee of training received from in-house sources, commercial sources (vendor-provided), and private sources. Next, employee ratings for effectiveness of training from each source are discussed. This is followed by a discussion of ratings for the levels of competency achieved from training from each of the method/source combinations. Tests for statistical significance of the data follow the discussions for each benefit. Appendices C, D, and E contain statistical test results for overall value; effectiveness, and competency achieved, respectively.

The next section includes results of a cost analysis of each of the two primary sources of PC training used by the Air Force today are presented. Costs for in-house training are outlined first, followed by costs for commercial, or vendor-provided training.

Finally, the last section in this chapter discusses the ranking of each method and each source of PC training. In-house and commercial sources of classroom training are compared first, then all sources and methods are ranked.

Survey Responses

The response rate predicted by officials at the 2750th Air Base Wing Civilian Personnel Office (of 25 percent) was not significantly different from the actual response rate of 34 percent (31). Of the 540 personnel surveyed, 184 responded. Of the 184 received, seven responses indicated that the respondents could not understand the survey well enough to complete it. Of the remaining 177 surveys, 26 contained responses for questions two and three concerning training which the respondents had not indicated they had taken. These 26 surveys were not used to compile the statistical data for the findings in this chapter, thus all findings are based on responses received from 151 government employees. The results of the sample of 151 from the estimated population of 19000 should be accurate to within

±7 percent of the population parameters with a 95 percent level of confidence.

Survey data was collected and input into microcomputer database and spreadsheet programs for data aggregation and analysis. Appendix B contains electronic spreadsheet printouts of the 151 responses for questions 1, 2, and 3., as well as some limited statistical data for each question item which includes the number of responses, the maximum and minimum values, and the average of and standard deviation for each question item. Other data mentioned elsewhere in this chapter came from various interactive inquiries made with the database program.

Employee Training Experience

The first question of the survey served a dual purpose: to identify which training methods and sources the 151 employees had been exposed to and what their reactions were.

Nearly all of the respondents, 150, had experienced at least one classroom PC training course. One hundred twenty-eight (128) employees had taken at least one in-house classroom training course. Almost as many, 108, had taken classroom training from a commercial source. The next largest group of employees (86) had taken classroom PC training from a private source, e.g., a university or college. Forty-two (42) employees had classroom training

only. Table I. shows the number of employees who had taken each method of PC training by source.

Table I. Employee Training Experience by Method

Source	Method	Number of Employees
In-House	Classroom	128
In-House	Video	50
In-House	CBT	84
Contract	Classroom	108
Contract	Video	39
Contract	CBT	62
Private	Classroom	86
Private	Video	42
Private	CBT	71

Those respondents who had taken video-based training comprised the smaller groups. Fifty-seven (57) respondents indicated they had taken at least one video-based PC training course. Employees who had taken vendor-provided video training were in the smallest group of 39.

A significant number of employees had been exposed to CBT training. One hundred three (103) employees had taken at least one computer course by CBT. More employees had taken CBT training from in-house sources than from contractors or universities; this was the third largest group categorized by method.

Thirty-three (33) employees indicated that they had taken all three methods of training from all three sources. Of the 151 respondents, 136 had taken at least one course

from an in-house source, 112 from a government contracted source, and 103 from a private source.

Most of the respondents had been exposed to a variety of training methods and sources. Eighteen (18) had taken training only from an in-house source and 10 had training only from a commercial source. None of the respondents had training *only* from a private source. Fifteen (15) employees indicated they had taken no training from an in-house source, 39 had no training from a commercial source, and 48 had no training from a private source.

Overall Value to the Employee

This particular benefit was used to measure the value to each employee's job of each method and source combination of microcomputer training. Value refers to the degree to which the training made the employee more productive, versatile, and, or effective in his/her job. Table II. summarizes the average ratings for each of the methods and sources surveyed. Please note that the numbers represent the percentage of the *ideal* level of value.

Primary Conclusions. Two primary conclusions are apparent from observing Table II. First, regardless of source, the preference of delivery method is classroom, CBT, then video, in terms of perceived value to the employee. Second, regardless of the method, there is no discernible difference in the perception of value with respect to in-

house, contract, or private sources of PC training. The reader should also note that although average ratings for the three sources of classroom training were in the 70s, actual modal responses were in the 80 to 90 range for in-house and commercial sources and in the 90 to 100 range for private sources. This should lead to the conclusion that the level of value to employees is higher than indicated by the mean responses for each method and source of PC training. A similar point is made regarding means and modes for other methods of training. Modal responses can be found in the Frequency Distribution tables in Appendix B.

Table II. Average Ratings for Overall Value

Source	Method	Average Rating
In-House	Classroom	74.375
In-House	Video	46.700
In-House	CBT	59.643
Contract	Classroom	75.324
Contract	Video	50.946
Contract	CBT	62.742
Private	Classroom	76.419
Private	Video	51.429
Private	CBT	63.028

In-House Training. The average response for overall value of in-house classroom training was the third highest among all methods. The modal response of 80 percent was the same for in-house classroom as for commercial classroom training. In-house training as a *source* of PC training,

however, received a lower rating for all three methods. Forty (40) percent of those employees who had taken training from a government source rated it above 80 as compared to 64 percent of the employees who had rated commercial training 80 or higher.

Of the 33 respondents who had taken *all three methods of training from all three sources,* five indicated that in-house classroom training was more valuable to their jobs than vendor-provided classroom training. Twice as many, (10) indicated vice-versa. Nearly half (14), however, felt in-house classroom training was more valuable than private classroom training. Sixteen (16) of the 33 rated in-house and commercial equally.

Eighty-six (86) employees had taken classroom training from both an in-house and a commercial source. Thirty-one (31) of those 86 responses rated commercial classroom training over in-house for overall value, 15 rated in-house higher, and 40 rated both equally.

In-House video training received the lowest average rating for overall value among all methods and sources. The modal response for this method was 50 percent. In fact, thirty-two (32) of the 50 people who had taken video training from an in-house source rated it at or below 50 percent.

More personnel (84) had taken CBT training from an in-house source than from the other two. The modal response

for this method was 70 percent; 42 of the 84 employees who had taken this method of PC training rated it higher than 70 percent for overall value.

Commercial Training. The average ratings for commercial training were higher than in-house training but lower than private training for all three methods in terms of overall value to the employees' jobs. Of the 69 employees who had taken classroom training from all three sources, the largest subgroup of 26 rated commercial training higher than in-house and 23 people rated commercial higher than private.

Employee preference for video training did not indicate any particularities; ratings were almost equally dispersed between all levels of value. Among those employees who had taken CBT training from two or more sources, commercial was rated higher than in-house and private sources. The response for commercial CBT training was bi-modal at 70 and 80. Thirty-eight (38) percent of those employees who had taken commercial CBT training rated it at or above 80. This compared to 44 percent of those who had rated CBT training from a private source at or above 80.

Private Training. The modal response for private classroom training was 90, as compared to 80 for both in-house and commercial classroom training. Nearly 64 percent of those employees who had taken classroom training from a private source rated it above 80 percent in terms of overall

value to their jobs. This compares to similar percentages for in-house and commercial of 60 and 63, respectively. Classroom training from private sources received the highest average rating among all methods (76.419 percent).

Video training from a private source was rated higher than commercial or in-house training as well, though ratings were almost as equally dispersed as those for commercial video training.

Employees also rated private source CBT higher than commercial or in-house. The modal response for this method was 80 percent. Forty-five (45) percent of employees who had taken this method rated it higher than 80 percent of the ideal level of value to the job.

Statistical Tests for Overall Value Ratings

The average ratings were tested for statistical significance to determine if there are indeed significant differences among the methods. As mentioned earlier in chapter III., the tests included the Z test and the Mann-Whitney test. The Mann-Whitney test was performed only to verify differences in means for in-house, vendor-provided, and private source classroom training. Results of each test are at Appendix C.

Z tests indicated that there were no statistical differences among sources of training for any of the methods at the five (5) percent level of significance.

Since the differences between methods were apparent, no tests were performed to compare one method to another. The Mann-Whitney tests also indicated that mean ratings for in-house and commercial classroom training were not statistically different. Essentially, this means that in-house classroom can be ranked equally with commercial classroom in terms of overall value to an employee's job. Recall that a primary focus of this thesis was to evaluate in-house versus vendor-provided classroom training. The Mann-Whitney test results indicate that, based on this sample, no difference exists between the two as to overall value to an employee's job.

Mann-Whitney tests comparing means for in-house and private source classroom training indicated that overall value ratings for private source classroom training were higher than those for in-house below the 88 percent level of probability. Private source ratings for overall value were also higher than commercial ratings below the 88 percent level. These results suggest some difference *may* exist between private and the other two sources of classroom training, but more evidence is needed before such a conclusion can be made.

Effectiveness of Training

This benefit was measured by the amount of material a student could effectively learn in one hour of PC training

as the result of the method and source of the training, not the course material. Each respondent was asked to assign a number which represents the percentage of the *most* that could be learned in one hour of training. Table III. contains the averages of ratings for training effectiveness of each method.

Primary Conclusions. Primary conclusions similar to those for Table II can be drawn from Table III. First, regardless of source, the preference of delivery method is classroom, CBT, then video, in terms of effectiveness perceived by employees. Second, regardless of the method, there is no practical difference in employees' perception of effectiveness of in-house, contract, or private sources of PC training. The reader is cautioned again that mean ratings presented in Table III do not necessarily indicate true levels of effectiveness. Modal responses for each method/source combination may be different than the average ratings which indicates that actual effectiveness of each method/source may be higher or lower. Further data about modal responses can be found in Frequency Distribution tables in Appendix B.

Table III. Average Ratings for Effectiveness

Source	Method	Average Rating
In-House	Classroom	69.258
In-House	Video	46.500
In-House	CBT	59.048
Contract	Classroom	73.333
Contract	Video	49.103
Contract	CBT	59.919
Private	Classroom	75.558
Private	Video	55.476
Private	CBT	66.408

In-House Training. The average ratings for effectiveness of in-house methods of micro training were lower than commercial and private sources by a larger margin than ratings of overall value in question 1. The majority (44 of 85) of those employees who had taken classroom training from both in-house and commercial sources rated the two equally for effectiveness. Fifteen (15) of the 85 rated in-house higher. Thirty-six (36) of the 81 people who had taken classroom training from in-house and private sources assigned equal ratings to both methods. Sixty-eight (68) personnel had taken classroom training from all three sources. Thirty-two (32) gave the same rating to all three sources; five (5) rated in-house higher than the other two.

Effectiveness of in-house video training was rated lower than video training from the other two sources. The lower ratings followed the same pattern found in ratings for overall value in question 1. The modal response for this

method was 60 percent. Forty (40) of the 50 employees who had taken video training from an in-house source rated it lower than 60 percent for training effectiveness. Responses for the other two sources of video training also followed a similar pattern, however.

In-house CBT training was also rated lower than CBT training from the other two sources. The modal response of 70 percent was one level lower than the modes for commercial and private CBT training of 80 percent. More than one-half of the employees who had taken CBT training from two or more sources rated in-house equally with the other source(s).

Commercial Training. The relationship of ratings for commercial sources of classroom PC training to ratings for in-house and private sources changed for question 2. The differences in average ratings increased between in-house and commercial by approximately four (4) percent and decreased between commercial and private by approximately one and one-half (1.5) percent. Twenty-six (26) of the 85 employees who had taken classroom training from in-house and commercial sources rated commercial higher, 44 rated them equal for effectiveness. Forty-one (41) employees who had taken classroom training from commercial and private sources rated both equally, 14 rated commercial higher.

Ratings for effectiveness of commercial video training also reflected a change in the relationships to ratings for in-house and private sources. Average effectiveness ratings for

commercial and in-house were closer than value ratings in question 1. The frequency of ratings for effectiveness levels of 60 percent and below increased as it did for in-house video training. Seven (7) of the 39 personnel who had taken video training from a commercial source rated it at or above 80 percent for effectiveness.

The difference in average ratings for commercial and private sources of CBT training increased while the difference in commercial and in-house CBT ratings decreased from question 1. A review of the frequency distribution of responses indicated that more responses occurred at levels below 70 percent thus lowering the average rating for this method.

Private Training. Ratings for effectiveness of private training sources increased with respect to value ratings for question 1 as well as effectiveness ratings for commercial and in-house sources. Classroom training from private sources again received the highest average rating - this time for effectiveness. The differences between this source and in-house and commercial sources of video and CBT training were greater for question 2. - effectiveness, than for overall value. The reader should note these differences in light of the fact that over half of the employees who had taken two or more sources of PC training still rated private, commercial, and in-house equally. Tests for

statistical significance were performed to identify any real differences in ratings.

Statistical Tests for Effectiveness Ratings

All but one Z-test was inconclusive at the five percent level of significance. The mean effectiveness rating for private sources of classroom training was statistically higher than the mean effectiveness rating for in-house classroom training. One other Z test which compared private and in-house sources of CBT training was significant at the six percent level; but this conclusion was rejected.

A Mann-Whitney test to compare the mean ratings for in-house and commercial classroom training was inconclusive above the 25 percent level of probability. The results indicate that effectiveness ratings for the two sources of classroom training are not statistically different.

A comparison of means ratings for effectiveness of in-house and private sources of classroom indicated a statistical difference at approximately the 61 percent level of probability, which suggests the two can be considered equal in terms of effectiveness. A comparison of means for vendor and private source classroom training effectiveness ratings was inconclusive at the 16 percent level of probability. These tests suggest that all three sources may considered equal in terms of training effectiveness, i.e., any of the three sources provides approximately the

same amount of material which can be mastered per training hour. Results of the tests are at Appendix D.

Employee Competency Achieved After Training

Survey question 3. was used to measure the level of competency employees felt they achieved after completing training in each method/source combination. Respondents were asked to assign a number which represented the percentage of material they could *master* as a result of the type of training. Table IV. contains the averages of responses for each method/source combination.

Primary Conclusions. Table IV also provides conclusions similar to those for Tables II and III. First, for any method, there are no differences among source. Second, the order of preference for methods of PC training is classroom, then CBT, then video from any of the three sources. The reader should note again that modal responses may be higher or lower than average ratings indicated in Table IV.

Table IV. Average Ratings for Competency

Source	Method	Average Rating
In-House	Classroom	73.398
In-House	Video	52.600
In-House	CBT	62.798
Contract	Classroom	74.028
Contract	Video	53.077
Contract	CBT	64.113
Private	Classroom	77.035
Private	Video	57.571
Private	CBT	69.113

In-House Training. The differences between average ratings for employee competency after training from in-house and commercial sources were less than differences between the two sources when rated for effectiveness. Ninety-six (96) of the 128 employees who had taken in-house classroom training rated it at or above 70 for question 3. The modal response for in-house classroom was 80, the same as for question 1. - value, and question 2. - effectiveness. One third, or 27 of the 81 people who had taken classroom training from both private and in-house sources rated private higher than in-house for competency achieved upon completing training; 49 rated the two equally. Nearly one third (21) of the 69 employees who had taken classroom training from all three sources rated private over in-house.

The average rating for competency achieved upon completion of in-house video training was the lowest for all method/source combinations. The modal response was 60, the

same as the mode for effectiveness, but higher than the mode of 50 for overall value. Twenty-five (25) of the 50 employees who had taken video training rated it at or above 60, compared to 18 of the 50 who rated it at or above 60 for value.

None of the 33 employees who had taken CBT training from all three sources rate in-house over both commercial and private sources; 2 rated in-house over commercial and 4 rated it over private for competency achieved after training. Twenty-three (23) of the 33 rated in-house equally with the other two sources for competency achieved upon completion of CBT training.

Commercial Training. Twenty-one (21) of the 86 people who had taken classroom training from both in-house and commercial sources rated commercial higher for competency achieved after training. Seventeen (17) of the 69 who had classroom training from all three sources rated commercial over in-house; 40 rated the two equally. Thirty-five (35) rated commercial equally with private sources of classroom training for competency achieved.

Twenty-seven (27) of the 33 employees who had taken video training from all three sources rated commercial and in-house sources the same; 21 rated commercial and private sources the same, four rated commercial over in-house or private.

Twenty-three (23) of the 46 people who had taken CBT training from all three sources, rated commercial equally with in-house and private sources; two rated commercial higher than both of the other sources, nine rated commercial over in-house, and seven rated commercial over private.

Private Training. Classroom training from private sources had the highest average rating among all methods and source combinations for competency achieved after completing training. The average ratings for competency achieved from private sources were higher than for in-house or commercial sources for video and CBT methods as well.

Statistical Tests for Competency Ratings

All Z tests were inconclusive at the five percent level of significance. The Mann-Whitney tests indicated that less than a 20 percent chance existed that the mean rating for commercial classroom training was higher than the mean for in-house classroom training or that the mean for private source classroom training was higher than that for in-house classroom training. This indicates that all three sources of training lead to the same level of achieved competency as a result of the classroom instruction method, approximately 73 to 77 percent of what employees feel the ideal course would provide. Results of the tests are at Appendix E.

The next section provides some idea of what one hour of classroom training from these two sources costs.

Costs of In-House Classroom Training

The author had to rely heavily on the cooperation of personnel on the AFLC headquarters and training division staffs for cost data. Most of the data used was estimated by the staffs based on current and historical expenditure rates and planned activities for the remainder of FY89. Some data was not available; most notably overhead costs. Neither staff felt they could accurately estimate management overhead costs. The reason cited most frequently by a number of knowledgeable individuals was the inability of current accounting procedures within the DOD Resource Management System (RMS) to track such costs. (1; 3; 4; 29)

Sources of Cost Data. All costs except personnel costs were provided by the Staff Development Program and Policy Support Branch of the Directorate of Communication-Computer Systems, Headquarters, Air Force Logistics Command, Wright-Patterson AFB OH. The number and grades of civilian and military personnel working in facility 110 were provided. Building costs are based on facility records. (3; 1; 5)

Costs for personnel were provided by the 2750th Air Base Wing Cost Analysis Branch, Wright-Patterson AFB OH. The branch cited Air Force Regulation 173-13, Air Force Cost and Planning Factors as the source for composite wages for military personnel and acceleration of civilian salaries (to reflect adjustments for retirement, Social Security, insurance, etc.). The source for base civilian salaries

(before acceleration) was cited as a report from the local civilian personnel office called the General Manager, General Schedule, and Federal Wage System Schedule and dated 30 May 89. (13)

Costs Included. Appendix F contains the costs and factors used to calculate the cost per training hour. Costs are divided into two sections, recurring and non-recurring. Non-recurring costs were not used to calculate the cost per training hour. Recurring costs are based on estimates for expenditures during FY89 for the following categories: supplies, travel, facility maintenance, equipment maintenance, replacement, or upgrade, personnel, and miscellaneous.

The majority of the travel expenditures are for travel performed by a mobile training team (MTT) which is composed of five rotating instructors from the division staff who travel to various bases within AFLC. Costs for supplies, equipment maintenance, and facility maintenance for training performed by the MTT at other bases are considered negligible.

The estimated total of recurring costs for the AFLC Training Division for FY89 is $891,579. An estimated 4,777 people will be trained in facility 110 during FY89. Another approximately 4500 personnel will be trained by the MTT. The average number of hours spent in PC training by each

individual student is 16. The estimated total number of PC training hours for FY89 is 148,432. (3)

Cost per Training Hour. The estimated annual cost per training hour, based only on recurring costs, for the AFLC Training Division is $6.01. This cost is based on the total recurring costs estimated for FY89 divided by the total number of student training hours provided by the division staff. The reader is cautioned that this cost does not reflect all elements necessary to be considered the true cost per training hour. Since this cost is derived using estimates and incomplete cost data (e.g. lack of overhead costs), it should ***not*** be considered absolutely accurate.

The estimated annual value of the 7,451 square feet utilized by the training division in building 110 is $147,468. The estimated value of division equipment is $200,000. The training staff emphasizes that the building and equipment could be utilized by virtually any other function in the headquarters; neither are unique to the training facility's mission. Building and equipment values are adjusted each year for depreciation. (1; 3)

Mr. Ron Patton, the Chief of the Training Division located in building 110, points out that the actual recurring cost per training hour would be probably lower if it reflected time spent by division employees in support of other base activities, such as in computer consulting and troubleshooting for other organizations on base (29).

Costs of Vendor-Provided Classroom Training

The author again, as with AFLC, had to rely heavily on the cooperation of the ASD personnel and logistics support staffs as sources of data. Most of ASD's data was also estimated based on current and historical expenditure rates and planned activities for the remainder of FY89. ASD overhead costs were also not available, as with AFLC. Similar reasons were cited by a number of individuals on the ASD personnel and logistics support staffs for non-availability of overhead costs, namely the lack of sufficient detail in current RMS reports. (17; 22)

Sources of Cost Data. Mr. Randy Hopper is an Employee Development Specialist assigned to the ASD Civilian Personnel Office. Mr. Hopper manages the three contracts which provide microcomputer training to ASD employees. He provided the contract costs per hour, the number and grades of personnel assigned to his function, the wages for the student hire, the number of individuals trained by contract, value of equipment used, the total square feet the function utilizes in building 125, the facility maintenance costs and the average number of hours spent in training by each individual (17). Ms. Debbie Large, a supply systems analyst, provided the estimated FY89 costs for supplies for Mr. Hopper's function (22). Cost per square foot for space utilized by Mr. Hopper's function were obtained from facility records (5).

Costs for personnel were provided by the 2750th Air Base Wing Cost Analysis Branch, Wright-Patterson AFB OH. The branch cited Air Force Regulation 173-13, Air Force Cost and Planning Factors as the source for composite wages for military personnel and acceleration of civilian salaries (to reflect adjustments for retirement, Social Security, insurance, etc.). The source for base civilian salaries (before acceleration) was cited as a report from the local civilian personnel office called the General Manager, General Schedule, and Federal Wage System Schedule and dated 30 May 89. (13)

Costs Included. Appendix G contains the cost data and factors used to calculate the cost per training hour for vendor-provided PC training. The costs are broken into three sections: recurring costs, contract costs, and non-recurring costs. Non-recurring costs were not used to calculate the cost per training hour. Recurring costs are based on estimates for expenditures during FY89 for the following categories: personnel, supplies, and facility maintenance.

Recurring costs do not include any official funded travel since none is required to support the microcomputer training contracts. The costs also do not reflect any equipment purchases since none are planned for the next three years. The recurring costs listed at Appendix G are those required to support Mr. Hopper and his staff and their

offices, as well as the two classrooms located in building 125 (17; 22). Approximately 25% of the contracted training is conducted by vendor employees in these two classrooms using government PCs. Vendor charges are the same for both on- and off-base training. (17)

The total estimated recurring costs for FY89 is $88,271. The estimated number of employees who will be trained by contract is 4000 (17). The average number of hours spent by each employee in training is 18 (17). The total estimated number of PC training hours per year is 72000. Total recurring costs divided by total training hours results in a recurring cost per hour of $1.23. This is the indirect cost of providing training through contract, and should be added to the average contract cost per hour.

Contract costs are based on the average of the costs per day stipulated in contract agreements between ASD and the three vendors. Mr. Hopper estimates that the total contracts cost for FY89 microcomputer training will be $350,000. The average contract cost per day is $25. ASD employees spend an average of six hours per day in training which results in an average contract cost per training hour of $4.17. (17)

Cost per Training Hour. The total of indirect and direct (contract) costs per training hour is $5.39. The reader is cautioned that this cost may not reflect all elements necessary to be considered an accurate cost per

training hour. Since this cost is derived using estimates and incomplete cost data it should ***not*** be considered completely accurate.

Non-recurring costs for the rooms and equipment used to support Mr. Hopper's function and on-base classroom training total to $74,268. Mr. Hopper indicated that the floor space and equipment could be used by almost any other function; neither are unique to his mission (17). The value of the facility and equipment used by Mr. Hopper's function is approximately 30 percent of the value of the facility and equipment used to support the AFLC in-house training function.

Ranking of Methods and Sources

Table V. indicates the ratios of benefits to cost-per-training hour for in-house and commercial sources of the classroom method of microcomputer training. The ratios for each source are computed by dividing the cost-per-training hour by the average rating from the survey for each benefit and multiplying by 1000. These ratios indicate the percentage of the ideal level of each benefit per dollar spent. The ratios do not reflect the fact that ratings for the two are not necessarily statistically different; this point is discussed after the table is presented. The higher ratios indicate higher ranking.

Table V. Cost-Benefit Ratios for In-House and Commercial Classroom Training

	In-House*	Commercial**
Overall Value	80.80	71.55
Effectiveness	86.77	73.50
Competency	81.88	72.81

* Cost-per-Training Hour is $6.01
** Cost-per-Training Hour is $5.39

The reader may interpret the ratios as follows: In-house classroom training provides 80.8 percent of the ideal level of overall value to the employee's job for every dollar spent per training hour; commercial classroom training provides 71.55 percent of the ideal level of overall value for each dollar spent per training hour.

The reader is cautioned that the ratios in Table V. should not be used for other than relative comparison purposes. Based on the Mann-Whitney tests, ratings for both in-house and commercial sources of classroom training are not statistically different for all three benefits. Since no statistical difference can be found in the ratings for both sources, cost-per-training hour may be used as the differentiating factor. The reader should also note that some evidence is presented to suggest that more resources are required to initially establish an in-house training function than to establish a contract-based training

program. Cost data for the models used in this thesis suggest that the difference in the amount of resources required can be as much as 300 percent.

Based on the cost and benefit data discussed earlier in this chapter, vendor-provided training provides the same levels of overall value to the employee, training effectiveness, and employee competency upon training completion at a lower cost.

Table VI. contains a ranking of all sources and methods based on the average of survey ratings for each benefit; costs are not considered.

Table VI. Ranking of Sources and Methods of Microcomputer Training

Source	Method	Value	Effectiveness	Competency
In-House	Classroom	3	3	3
	Video	9	9	9
	CBT	6	6	6
Commercial	Classroom	2	2	2
	Video	8	8	8
	CBT	5	5	5
Private	Classroom	1	1	1
	Video	7	7	7
	CBT	4	4	4

A ranking of each method and source combination considering all three benefits simultaneously would produce the same order iterated in Table VI.

A ranking of methods without consideration of source indicates that classroom training is preferred over CBT training which is preferred over video-based PC training.

The next chapter presents conclusions based on the findings in this chapter and recommendations for further consideration of related topics.

V. Conclusions and Recommendations

Introduction

Three sources of microcomputer training and three methods used by these sources were evaluated in this thesis in terms of their overall value, effectiveness, and results. Examples of the use of these sources and methods of PC training on Wright-Patterson AFB, Ohio were also discussed and analyzed. A primary focus of this thesis was to compare a government in-house training facility to a government-contracted vendor training program. The results of each of the evaluations, analyses, and comparisons yielded the conclusions and recommendations that follow.

Conclusions

Based on the cost and benefit data discussed in chapter IV., a number of preliminary conclusions are presented herein for the reader's *careful* consideration. The word careful is stressed since the benefit data is based on one sample of a large population and the cost data contains a number of estimated, rather than actual costs.

The first conclusion that can be made from analysis of the data is that classroom training is preferred over either CBT or video-based PC training. The mean ratings of classroom training for all three benefits were statistically and significantly higher than ratings for the other two methods. This conclusion echoes the popularity of

instructor-led training as the traditional and most often used method of PC training as mentioned in chapter II.

Another conclusion which can be made is that in-house, commercial, and private sources of PC training, regardless of the methods used, are equal in terms of overall value to government employees, training effectiveness, and level of competency achieved upon completion. Data used in this thesis provided overwhelming evidence to this with one minor exception. A Z test to compare the mean ratings for effectiveness of private source classroom training to in-house classroom training indicated that the mean for private was *slightly* higher. A Mann-Whitney test for the same comparison was inconclusive. Furthermore, the modal response for the two was the same. An admitted weakness in this analysis is the lack of adequate data on the viability of utilizing private sources for training government employees. Despite this weakness, the reader can effectively conclude that all three sources are equally effective.

A third conclusion which can be made is that little or no difference exists between government provided in-house microcomputer training and government contracted vendor-provided training. The average survey ratings for the two sources were not statistically different and the cost-per-training hour for each source differed by $.62 per hour. This suggests that decisions about which source to choose

should reflect consideration of the total costs of choosing one source over the other. As mentioned in chapter II, large organizations are developing in-house training functions when they find the cost of such functions is lower than the cost of training procured by contract from a commercial vendor.

The last conclusion which might be made from the data presented is that government in-house training functions can require more resources than training through contracted sources. Although no specific evidence was presented to demonstrate that the costs of each source of PC training are representative of other such programs elsewhere in the Air Force of DOD, some general points can be made nonetheless. Facility and equipment costs for the AFLC in-house training function discussed in this thesis, for example, were over 300 percent greater than those for the ASD training-by-contract program. The amount of floor space and equipment needed for in-house training functions will more than likely exceed that required for vendor-provided training, particularly if most or all vendor training is conducted off-site. Likewise, less personnel are needed to support a training-by-contract program such as that in ASD.

Decision makers should consider these points in addition to the trade-offs between an in-house and vendor training programs. Examples of such trade-off considerations are initial investment of resources,

recurring costs, flexibility for course content, length, and focus, and employee convenience. These considerations along with an analysis of the benefits studied herein, i.e., overall value, training effectiveness, and competency achieved, should form the basis for decisions on which sources and methods of PC training to use.

The next section suggests some ideas for further study of these and related topics which can serve to improve the information available to managers for making such decisions.

Recommended Areas for Further Study

The first area recommended by the author as one which requires more detailed research is cost data. Admittedly, the cost data used herein were less than desirable for making concrete conclusions about in-house and vendor-provided training. The lack of accuracy and detail in Resource Management Systems reports required a significant number of estimates by personnel whose jobs did not require cost estimation expertise. Efforts to collect data using cost estimation techniques were furthered hampered by the lack of complete historical data since the AFLC and ASD models involved major changes from previous years. Data for FY89, if collected at fiscal year end, would provide a better data base for cost analysis since both programs are expected to be more stable during this fiscal year.

A second area which requires further attention involves competency levels achieved upon completion of PC training. Currently, AFLC tests all students at the end of each course. ASD does not require the three contractors to do so, and no plans for such a requirement exist. A number of private sector examples should be available in the near future, based on indications found during the literature review for this thesis. Interviews with Air Training Command personnel (not cited) also indicated that some bases may require vendors to test employees in the future; as of 1989, none are known to have such a requirement.

Another area which should be researched is the viability of contracting with universities and colleges to provide PC training. This was briefly mentioned in chapter II as being attempted on a limited basis by some bases in the Air Force. Based on the survey ratings for private sources, this alternative might prove more desirable than other sources currently used. Cost data for this particular source are also needed.

Since the findings in this thesis are based on only one data sample, additional samples from other bases and, or services should be surveyed for similar data. Such surveys might be directed toward employees, as was the case herein, or toward supervisors of the employees.

At the time this thesis was nearing completion, the popularity of CBT and interactive-video instruction was on

the rise. Additional research about these two methods of PC training should be directed at their potential applications in the Air Force and DOD.

Summary

Computer technology and its rapid development have intensified the challenge to managers of all organizations to manage computers as effectively as any other resource. The Air Force has recognized that, to achieve its goal of a PC on every desktop, training is one of the more critical requirements which must be met. Unfortunately, meeting the ever-changing training requirements has become a task which requires new and innovative actions by base/wing and major command level managers.

Some of the methods and sources of PC training available to Air Force managers were studied in this thesis. A primary focus was the comparison of the two more popular sources and the most popular method of microcomputer training used in the Air Force today: in-house and commercial classroom training. The results of this comparison indicated that these two sources of classroom training can be considered equal in terms of overall value to the employee's job, training effectiveness, and the level of competency achieved by the employee upon training completion. The results also indicated that substantially more resources are required to establish and maintain in-

house training functions than to establish and maintain support vendor-provided training. Although additional research is needed to refine the cost estimates, based on the data used, recurring cost-per-training hour is slightly higher for in-house than for vendor-provided training.

A survey of government employees revealed that they prefer classroom microcomputer training over computer-based training (CBT) and CBT over video-based training in terms of overall value, training effectiveness, and competency achieved.

These findings should be combined with further research into the true costs and benefits of in-house, commercial, and private sources for a variety of PC training methods to include computer-based training (CBT), interactive-video instruction, and video-based training. Such further research should be aimed at providing USAF and DOD decision makers with quantitative and qualitative data for use in choosing which sources and methods to utilize for training government employees.

Appendix A: Survey Questionnaire Used

Survey Control No. 89-59

SURVEY EVALUATION OF MICROCOMPUTER TRAINING

This survey asks you to evaluate various types of computer training used in the Air Force today. In the questions below, you are asked to use numbers which represent a percentage of the ideal level of employee value, training effectiveness, and student competency which result from the *type* of training, not the course material. Assume that 100 represents the ideal level and use numbers in increments of 10, e.g., 10, 20, 30, 40, etc., up to 100. For example, if you feel video-based training provides only 80% of the what you'd ideally expect to get from a course, you would assign an 80 in the space provided to the left of that type of training.

1. This question is designed to do two things: a) determine which types of training you have completed; and b) how you would rate the types of training you have received in terms of overall value to you as a government employee. By overall value, we mean the degree to which the training made you more productive, versatile, and, or effective in your job. Remember, 100 represents the ideal level of value to you as an employee. Assign a number only to those types of training you have completed (even if you've only had one).

IN-HOUSE (officially provided by government employees):

___ a. Classroom training (traditional student-instructor)

___ b. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ c. Computer-based training (computer software "instructs" and prompts student for input)

COMMERCIAL (through use of government contract):

___ d. Classroom training (traditional student-instructor)

___ e. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ f. Computer-based training (computer software "instructs" and prompts student for input)

PRIVATE (through your own efforts or off-duty):

___ g. Classroom training (high school, college, university)

___ h. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ i. Computer-based training (computer software "instructs" and prompts student for input)

2. This question asks you to determine how much you can effectively learn from a course as a result of the type of training used. Assume that 100 represents the most material you could effectively learn in one hour of training. For each of the types of training you have taken, assign a number which represents the amount of material you feel can be learned for *each hour* of training.

IN-HOUSE (officially provided by government employees):

___ a. Classroom training (traditional student-instructor)

___ b. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ c. Computer-based training (computer software "instructs" and prompts student for input)

COMMERCIAL (through use of government contract):

___ d. Classroom training (traditional student-instructor)

___ e. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ f. Computer-based training (computer software "instructs" and prompts student for input)

PRIVATE (through your own efforts or off-duty):

___ g. Classroom training (high school, college, university)

___ h. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ i. Computer-based training (computer software "instructs" and prompts student for input)

3. This question asks you to determine your level of competence upon completion of each type of training you received. For example, if you took a course, but felt you could only master 60% of the course material *because of the type of training used*, assign a 60.

IN-HOUSE (officially provided by government employees):

___ a. Classroom training (traditional student-instructor)

___ b. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ c. Computer-based training (computer software "instructs" and prompts student for input)

COMMERCIAL (through use of government contract):

___ d. Classroom training (traditional student-instructor)

___ e. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ f. Computer-based training (computer software "instructs" and prompts student for input)

PRIVATE (through your own efforts or off-duty):

___ g. Classroom training (high school, college, university)

___ h. Video-based training (typically requires students to observe a video tape rather than a human instructor)

___ i. Computer-based training (computer software "instructs" and prompts student for input)

Thank-you very much for your time. We appreciate you cooperation. Please use the enclosed return envelope to return this survey.

Appendix B: Electronic Spreadsheet Printouts Containing Data Collected

The printouts follow this page

Question 1. Overall Value

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
1	60	10	20	50	10	20	50	10	10
2	50		50	50		50	50		50
3	80								70
4	30		70	40		70	40		80
5	60	70	90	70	80	100	50	80	100
6				80					
7	100	90	70	100	90	70	100	90	70
8	80								
9	20		80	20		80			
10	90		70	90		70	90		60
11	70	50	60	80	50	70	40	40	60
12	100								
13	80	80	80	80	80	80	70	80	80
14	60	40	10	70	40	20	20	20	60
15	60			80					
16	60			80					
17			60	60					
18	50	50	70	60	50	80	60	50	80
19	50	50	50	80	50	50	20	20	20
20	20		50	90		50	80		
21	100	40	70	100	60	70	70	60	70
22	80						70		
23	90								
24	90		80	90		80	100		80
25	70			50					
26				50		50			
27				70			100		
28			50	80					50
29	80	10	10	40	10	10	80	10	10
30			100			100			100
31				90					
32	90	60	30	90	60	30	80	50	20
33	70								
34	80	60	70	80	60	70	80	60	70
35	100								
36	70	40	60	80	40	60			
37				50					80
38	60								
39				70					
40				50					
41				50					
42	80	70		90		90	90		
43				80					
44	90	50	80	90	50	80	100	50	70

Question 1. Overall Value

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
45	80								
46	70								80
47	80			10					
48	80			90			60		
49	70		70	80	70	80	85	75	90
50	75	10	25						80
51	95		90	80			95	50	
52	60						30		10
53	90		10			10			
54	90	80	90	90	80	90	85	80	85
55	80	80	40	100	85	45	100	60	60
56	85								
57	65		85			85	70		
58	80			100			100		
59	80	40	60	80	40	60			
60	10						90		
61	70		40				90		
62	90		90				90		
63	70	70	80	80	70	80	90	90	90
64	100		100	100		100	100		100
65				20					80
66	90	70	80	80	70	80	60	50	50
67	75			75			90		
68	70	50	70						
69	100								70
70		50	50	50					
71				70					
72	90								80
73	90			80					
74	100								80
75	100								80
76	90	75	60	90					
77	90	50	80	90	50	80	90	50	80
78	80								
79	80		90	80		90			
80	50		50	100			50	25	25
81	70	20	30	70	20	30	80	20	30
82	80		80	80		80	80		80
83	70						70		
84	10	10	10						
85	100								
86	80	30	50	80	50	70	70	70	60
87	90					50			
88				90		85			

Question 1. Overall Value

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
89				90			30		
90	50			50					
91	70								
92	100	60	80	100	60	80	100	60	90
93	65		85	75		90	77		80
94	80		90				90		100
95	80	50	70						
96	90		50						
97	80	40	30	90	40	30	90	40	30
98	30	35		45	30	25	85		
99				60	30	10	80	10	10
100	80			80			80		
101	90		70				90		80
102	90		70	80		70	90	70	70
103	80		100	90			50		100
104	80			60					60
105	50			40					95
106	70	50	40	80			90		
107			40	80			80		
108	80	30	30				80	30	30
109	70			80			80		
110	90			90					
111	70			70			70		
112	100	50	80	100	30	60	90	40	50
113	60	30	30	70			70		
114	20	40	60	70	60	70	60	70	60
115	30			70			50		
116	90	80	100	90	80	100	90	80	100
117	90			80			100		90
118	90								
119	100	70	70	100	70	70	100	70	70
120	100		90	100		90	90		80
121	60			50			60		
122	70			80					50
123	60	10	30	60	20	40	70		30
124		20		90					
125	90		70	90		70	90		
126	80	70	70				80	60	50
127	80						60		
128			60	70		60	90		
129	100		50	100		50	100		50
130	60		70	70					80
131	40		20						50
132	75	30	50	80			90		

Question 1. Overall Value

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
133	100		65	100			95	70	65
134	80	70	60	80	70	60	80	70	60
135	90			90					
136	100	10	40	100	10	40	100	10	40
137	80	70	80	90	70	80	80	70	80
138	90			70			90		
139	80		60	80		60	90		
140			60	70					
141				60					
142	70			80			60		
143	40		20						
144	60							80	
145	80		70	80			60		
146	60								
147	10								
148	75	15	10	50	40	10	50	40	10
149	90	70	70	90	70	70	90	70	75
150	60	20	40	60	20	50	10	20	30
151	70	10	20	60	10	40	100	10	10
# Resp's	128	50	84	108	39	62	86	42	71
Average:	74.375	46.700	59.643	75.324	50.641	62.742	76.419	51.429	63.028
Std Dev.	20.66	23.12	24.15	18.69	22.93	24.41	20.89	24.38	25.94

FREQUENCY DISTRIBUTION - number of responses within each increment of 10.

	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
10	3	7	5	1	4	4	1	5	6
20	3	4	4	2	3	2	2	4	2
30	3	4	7	0	3	4	2	2	6
40	2	7	6	3	5	3	2	4	1
50	6	10	10	12	6	8	7	6	8
60	14	3	10	8	5	6	8	5	8
70	20	9	18	14	7	12	9	8	9
80	34	5	11	33	4	12	15	6	19
90	26	1	9	22	2	7	25	2	5
100	17	0	4	13	0	4	15	0	7
	128	50	84	108	39	62	86	42	71

Question 2. Effectiveness

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
1	40	10	10	40	10	10	30	10	10
2	50		50	50		50	50		50
3	60								60
4	10		60	10		60	10		70
5	40	60	80	50	60	80	60	80	100
6				70					
7	90	100	100	90	100	100	90	100	100
8	80								
9	30		70	30		70			
10	70		30	80		30	80		30
11	30	60	80	40	60	80	60	60	80
12	80								
13	80	80	80	80	80	80	80	80	80
14	60	40	30	60	30	30	50	40	40
15	50			80					
16	50			80					
17			70	80					
18	50	50	80	60	50	80	60	60	80
19	80	50	50	50	50	50	50	50	50
20	40		60	100		80	100		
21	100	60	80	100	60	80	100	60	80
22	90						90		
23	80								
24	60		80	70		80	80		80
25	60			60					
26				80		50			
27				90			90		
28			40	50					80
29	80	10	10	70	10	10	80	10	10
30			100			100			100
31				80					
32	80	40	10	80	40	10	70	30	10
33	90								
34	90	60	70	90	60	70	90	60	70
35	90								
36	40	40	60	50	40	60			
37				90					80
38	60								
39				80					
40				50					
41				50					
42	80	60		80		90	90		
43				80					
44	80	50	70	90	50	70	100	50	70

Question 2. Effectiveness

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
45	70								
46	80								80
47	70			60					
48	95			80			50		
49	75		65	80	75	75	80	75	85
50	45	10	25						80
51	80		90	60			80	50	
52	90						75		85
53	80		20			20			
54	90	80	85	90	80	85	80	70	70
55	90	50	50	100	60	55	100	40	40
56	85								
57	40		60			60	50		
58	75			80			80		
59	90	50	60	90	50	60			
60	10						90		
61	70		60				80		
62	80		80				90		
63	70	70	80	90	80	90	90	100	100
64	100		80	100		80	100		80
65				100					80
66	80	50	60	70	50	50	50	40	50
67	30			30			40		
68	100	70	100						
69	100								80
70		60	60	40					
71				70					
72	90								80
73	20			10					
74	90								70
75	90								70
76	75	60	70	75					
77	50	30	40	50	30	40	50	40	30
78	80								
79	25		75	80		90			
80	85		85	85			85	75	85
81	80	20	30	80	20	30	80	20	30
82	70		70	70		70	70		70
83	80						80		
84	70	10	10						
85	5								
86	40	40	30	70	60	90	70	40	80
87	90					60			
88				80		75			

Question 2. Effectiveness

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
89				100			50		
90	70			70					
91	30								
92	90	80	100	90	80	100	90	80	100
93	65		75	80		85	78		80
94	70		90				80		100
95	90	70	70						
96	90		50						
97	80	40	30	90	40	30	90	40	30
98	15	25		40	20	20	55		
99				100	60	60	100	60	60
100	70			70			70		
101	80		80				80		80
102	90		90	70		90	80	90	90
103	20		40	30			10		40
104	80			60					60
105	75			75					90
106	70	50	40	80			90		
107			20	80			80		
108	80	30	30				80	30	30
109	90			90			90		
110	90			90					
111	100			100			100		
112	60	50	70	40	40	40	100	80	90
113	80	20	30	80			80		
114	50	60	70	40	30	50	60	60	60
115	100			90			100		
116	50	60	80	60	60	85	65	60	85
117	100			100			100		100
118	90								
119	100	80	80	100	80	80	100	80	80
120	80		70	80		70	70		60
121	60			50			60		
122	50			80					70
123	30	10	60	40	10	50	50		50
124		30		90					
125	80		20	80		20	80		
126	70	40	40				80	60	60
127	90						80		
128			90	70		80	90		
129	100		10	100		50	100		50
130	40		80	30					80
131	20		30						50
132	80	50	70	95			95		

Question 2. Effectiveness

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
133	100		65	100			95	70	65
134	80	70	60	80	70	60	80	70	60
135	90			90					
136	100	10	40	100	10	40	100	10	40
137	80	60	70	90	70	90	80	60	80
138	100			100			100		
139	60		70	60		5	60		
140			90	90					
141				90					
142	80			80			80		
143	40		40						
144	60							80	
145	80		60	80			60		
146	30								
147	10								
148	75	20	5	50	40	10	50	40	10
149	90	70	70	90	70	70	90	70	70
150	80	20	60	80	20	60	60	40	60
151	30	10	60	70	10	20	30	10	60
# Resp's	128	50	84	108	39	62	86	42	71
Average:	69.258	46.500	59.048	73.333	49.103	59.919	75.558	55.476	66.408
Std Dev.	24.18	22.68	24.67	20.95	23.75	26.05	20.39	23.60	23.35

FREQUENCY DISTRIBUTION - number of responses within each increment of 10.

	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
10	4	7	6	2	5	5	2	4	4
20	4	4	3	0	3	4	0	1	0
30	8	4	9	4	3	4	2	2	5
40	8	6	7	7	5	3	1	8	4
50	9	9	4	10	5	7	10	3	6
60	9	10	13	8	8	9	9	9	9
70	13	5	16	12	3	6	6	4	10
80	35	4	15	30	6	12	25	8	19
90	25	0	7	20	0	9	15	1	7
100	13	1	4	15	1	3	16	2	7
	128	50	84	108	39	62	86	42	71

Question 3. Competency

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
1	70	30	40	60	30	30	50	20	20
2	50		50	50		50	50		50
3	70								80
4	90		100	90		90	90		100
5	50	70	100	50	70	100	50	70	100
6				70					
7	100	90	80	100	90	80	100	90	80
8	90								
9	60		40	60		40			
10	100		100	100		100	100		100
11	70	60	80	70	60	80	70	60	80
12	90								
13	90	90	90	90	90	90	90	90	90
14	80	50	70	80	60	60	80	60	60
15	40			80					
16	40			80					
17			40	30					
18	50	50	70	60	50	80	70	50	80
19	60	60	60	50	50	50	80	80	80
20	10		40	80		40	100		
21	100	100	100	100	100	100	100	100	100
22	80						70		
23	80								
24	80		70	80		70	90		70
25	80			40					
26				80		50			
27				70			90		
28			50	90					50
29	80	50	10	80	50	40	80	50	40
30			50			50			50
31				70					
32	100	80	60	100	80	60	80	60	50
33	90								
34	90	70	80	90	70	80	90	80	60
35	90								
36	70	60	70	70	60	70			
37				80					100
38	60								
39				50					
40				50					
41				50					
42	90	90		90		90	90		
43				80					
44	70	50	80	100	50	70	80	50	70

Question 3. Competency

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
45	90								
46	70								80
47	70			40					
48	95			70			90		
49	70		75	75	70	75	80	70	85
50	100	100	100						100
51	70		80	50			70	50	
52	80						90		85
53	90		5			5			
54	70	65	75	70	75	75	80	80	85
55	95	60	60	80	60	35	100	60	30
56	70								
57	45		60			60	55		
58	75			80			85		
59	70	30	50	70	30	50			
60	10						90		
61	50		40				70		
62	80		80				80		
63	60	50	70	80	80	80	90	90	90
64	80		85	80		85	80		85
65				60					80
66	80	50	60	70	50	50	50	40	50
67	60			60			70		
68	90	70	90						
69	90								70
70		60	50	80					
71				70					
72	70								70
73	50			40					
74	100								70
75	100								70
76	80	50	60	80					
77	70	40	40	70	40	40	70	40	40
78	80								
79	90		90	90		90			
80	85		85	85			85	50	85
81	70	15	10	70	15	10	75	30	15
82	70		70	70		70	70		70
83	80						70		
84	70	10	10						
85	95								
86	80	70	80	90	70	90	80	60	80
87	90					60			
88				75		70			

Question 3. Competency

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
89				90			90		
90	60			60					
91	20								
92	80	60	100	80	60	100	80	60	100
93	80		80	75		85	80		82
94	100		80				60		90
95	80	70	70						
96	90		75						
97	60	50	20	70	50	30	70	50	30
98	15	15		20	15	20	40		
99				100	60	60	100	70	70
100	70			70			70		
101	70		80				90		70
102	50		60	50		60	60	60	60
103	80		100	90			40		90
104	80			60					60
105	40			40					75
106	60	40	30	70			80		
107			10	50			75		
108	70	40	40				80	40	40
109	100			100			100		
110	90			90					
111	100			100			100		
112	100	40	80	100	40	80	100	80	90
113	90	60	30	70			80		
114	50	60	40	70	50	60	60	70	80
115	100			90			100		
116	75	50	100	85	50	100	85	50	100
117	100			100			100		100
118	80								
119	100	80	80	100	80	80	100	80	80
120	80		70	80		70	70		70
121	40			30			30		
122	30			70					60
123	70	30	90	70	30	90	70		90
124		60		90					
125	100		60	100		60	100		
126	80	60	60				80	60	40
127	70						50		
128			100	80		90	90		
129	50		50	75		50	75		50
130	80		90	90					90
131	40		30						50
132	75	30	70	80			90		

Question 3. Competency

Response	IN-HOUSE			COMM'L			PRIVATE		
	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
133	90		55	90			85	63	55
134	80	80	70	80	80	70	80	80	70
135	90			90					
136	70	30	40	70	30	40	70	30	40
137	90	60	80	90	60	80	80	60	80
138	80			100			60		
139	80		50	80		50	80		
140			70	80					
141				90					
142	80			90			80		
143	40		40						
144	60							60	
145	80		50	80			40		
146	50								
147	10								
148	75	20	5	50	40	10	50	40	10
149	95	5	85	95	5	85	95	5	85
150	80	10	20	10	10	30	10	20	30
151	30	10	60	30	10	60	70	10	20
# Resp's	128	50	84	108	39	62	86	42	71
Average:	73.398	52.600	62.798	74.028	53.077	64.113	77.035	57.571	69.113
Std Dev.	20.88	23.69	25.32	19.20	23.44	23.84	17.90	21.65	23.11

FREQUENCY DISTRIBUTION - number of responses within each increment of 10.

	Class	Video	CBT	Class	Video	CBT	Class	Video	CBT
10	3	4	6	1	3	3	1	2	1
20	2	3	2	1	2	1	0	2	3
30	2	5	3	3	4	3	1	2	3
40	6	4	10	4	3	6	3	4	5
50	10	9	8	10	8	8	6	7	7
60	9	11	11	7	7	9	5	10	6
70	23	6	11	21	4	7	15	5	11
80	33	3	16	27	5	10	23	6	12
90	21	3	8	20	2	10	18	3	14
100	19	2	9	14	1	5	14	1	9
	128	50	84	108	39	62	86	42	71

Appendix C: Results of Statistical Tests for Survey Ratings on Overall Value

Statistical tests were performed to test the hypothesis that means for ratings of each of two sources compared were statistically different. The levels of probability indicated in the respective columns below are the levels at which the hypothesis can be rejected. Z-test results are based on two-tailed tests. Results for Mann-Whitney tests are based on two-tailed tests for comparison of means of non-paired sample data. A five percent level of significance for the two-tailed tests was required for a 95 percent level of probability to reject the hypothesis that the means are equal. That is, a probability in the table below that is less than .95 indicates no significant difference between means. Abbreviations are used for sources: I for in-house, C for commercial, and P for private.

Method	Sources Compared	Z-test	Mann-Whitney
Classroom	C-I	.2886	.1114
	P-I	.5160	.8836
	P-C	.2886	.8836
Video-based	C-I	.5762	
	P-I	.6528	
	P-C	.1114	
CBT	C-I	.5528	
	P-I	.5934	
	P-C	.0478	

Appendix D: Results of Statistical Tests for Survey Ratings on Effectiveness

Statistical tests were performed to test the hypothesis that means for ratings of each of two sources compared were statistically different. The levels of probability indicated in the respective columns below are the levels at which the hypothesis can be rejected. Z-test results are based on two-tailed tests. Results for Mann-Whitney tests are based on two-tailed tests for comparison of means of non-paired sample data. A five percent level of significance for the two-tailed test was required for a 95 percent level of probability to reject the hypothesis that the means are equal. That is, a probability in the table below that is less than .95 indicates no significant difference between means. Abbreviations are used for sources: I for in-house, C for commercial, and P for private.

Method	Sources Compared	Z-test	Mann-Whitney
Classroom	C-I	.8324	.2510
	P-I	.9596	.6156
	P-C	.5408	.1664
Video-based	C-I	.3970	
	P-I	.9342	
	P-C	.7738	
CBT	C-I	.1586	
	P-I	.9426	
	P-C	.8664	

Appendix E: Results of Statistical Tests for Survey Ratings on Competency Achieved

Statistical tests were performed to test the hypothesis that means for ratings of each of two sources compared were statistically different. The levels of probability indicated in the respective columns below are the levels at which the hypothesis can be rejected. Z-test results are based on two-tailed tests. Results for Mann-Whitney tests are based on two-tailed tests for comparison of means of non-paired sample data. A five percent level of significance for the two-tailed test was required for a 95 percent level of probability to reject the hypothesis that the means are equal. That is, a probability in the table that is less than .95 indicates no significant difference between means. Abbreviations are used for sources: I for in-house, C for commercial, and P for private.

Method	Sources Compared	Z-test	Mann-Whitney
Classroom	C-I	.1896	.1896
	P-I	.8262	.1974
	P-C	.7372	.0008
Video-based	C-I	.0718	
	P-I	.7062	
	P-C	.6266	
CBT	C-I	.2510	
	P-I	.8948	
	P-C	.7776	

Appendix F: Estimated AFLC Training Costs for FY89

RECURRING COSTS - (estimated)	FY 89 ($)
Supplies	$93,100
Travel	$46,550
Personnel	$728,829
Equipment	$22,500
Misc	$600
Facility Maint	$29,260
	$891,579

Number of People Trained	
In BLDG 110:	4777
By MTT:	4500
Total:	9277
Avg hrs per individual in Training:	16
Estimated # of PC Training hours/Yr:	148432
Est cost per hour:	$6.01

NON-RECURRING COSTS - (for BLDG 110)

Building	$147,468
Equipment	$200,000
	$347,468

No. trained in BLDG 110:	4777
Avg hrs per individual:	16
Est # of training hrs/yr:	76432
Est cost per hour:	$4.55

Grade	No.	Ann Wage	Total
GM13	2	$63,320	$126,639
GS12	1	$53,239	$53,239
GS11	2	$44,432	$88,864
GS9	2	$36,710	$73,421
GS7	5	$30,032	$150,160
GS5	7	$24,251	$169,757
E6	1	$30,555	$30,555
E5	1	$36,194	$36,194
Total:	21		$728,829

Appendix G: Estimated ASD Training Costs for FY89

RECURRING COSTS - (estimated)

	FY89 ($)		
Personnel	$85,271	Est # Trained:	4000
Supplies	$2,500		
Facility Maint	$500	Average # hours spent	
		in Training:	18
	$88,271		
		Estimated # of PC	
		Training hours/Yr:	72000

CONTRACT COST PER HOUR

Avg cost per day:	$25.00	Est cost per hour:	$1.23
Training hours per day:	6	Avg contract $/hr:	$4.17
Avg cost per hour:	$4.17	Total:	$5.39

NON-RECURRING COSTS - (for BLDG 125)

Building		$48,268
Cost per Sq Ft:	$14.06	
# of sq ft:	3433	
Equipment		$26,000
		$74,268

Personnel

Grade	No.	Ann Wage	Total
GS12	1	$53,239	$53,239
GS6	1	$30,032	$30,032
Stud Temp	1	$2,000	$2,000
Total:	2		$85,271

Bibliography

1. Baker, Ron, Facilities Programming Specialist, Directorate of Communication-Computer Systems, Headquarters, Air Force Logistics Command. Telephone interview. Wright-Patterson AFB OH, 11 August 1989.

2. Caver, Lt Keith A. End User Software Development For Transportation Applications. MS thesis, AFIT/GLM/LSMA/87S-12. School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB OH, September 1987 (AD-A187-912).

3. Clark, Mitch, Staff Program and Policy Development Support Branch, Directorate of Communication-Computer Systems, Headquarters, Air Force Logistics Command. Telephone interview. Wright-Patterson AFB OH, 2 August 1989.

4. Crouse, Ray, Training Division, Directorate of Human Resources, Air Force Logistics Command. Personal interview. Wright-Patterson AFB OH, 16 May 1989.

5. Department of the Air Force. Real Property Inventory Detail Report. Government Report. Wright-Patterson AFB OH: 2750th ABW/DEER, 15 March 1989.

6. Department of Defense. The Impact of Low Cost Computing Technologies on the Department of Defense. Government Report. Washington: Arthur Young and Company, 1983 (A128489).

7. Elwood, George, Director of Training, Logistics Systems Architects. Personal interview. Dayton OH, 16 May 1989.

8. Fisher, Audrey. "Personnel Training Programs Explain Technology With Precision," Administrative Management, 48: 17-21 (April 1987).

9. Gibson, Cyrus F. and Richard L. Nolan. "Managing the Four Stages of EDP Growth," Harvard Business Review, 53: 76-88 (January-February 1974).

10. Griffin, Mac, Acting Chief, Air Force Small Computer Office Automation Service. Telephone Interview. Gunter AFB AL, 6 February 1989.

11. Griffin, Mac, Chief, Multi-User Branch, Air Force Small Computer Office Automation Service. Telephone Interview. Gunter AFB AL, 18 July 1989.

12. Guimaraes, Tor and Vasudevan Ramanujam. "Personal Computing Trends and Problems: An Empirical Study," MIS Quarterly, 10: 178-187 (June 1986).

13. Huttner, Sergeant Greg, 2750th Air Base Wing Cost Analysis Branch. Telephone interview. Wright-Patterson AFB OH, 14 Aug 89.

14. Hall-Sheehy, Jim. "Let's Forget Computer Literacy," Training and Development Journal, 39: 24-25 (July 1985).

15. Hartog, Curt and Martin Herbert. "1985 Opinion Survey of MIS Managers: Key Issues," MIS Quarterly, 10: 350-361 (December 1986).

16. Henderson, John C. and Michael E. Treacy. "Managing End User Computing for Competitive Advantage," Sloan Management Review, 27: 3-14 (Winter 1986).

17. Hopper, Randy, Employee Development Specialist, Aeronautical Systems Division. Telephone interview. Wright-Patterson AFB OH, 2 August 1989.

18. James, Major Thomas G., Jr. ACSC Introduction to Microcomputers for Air Force Leaders. Student Report, ACSC 87-1330. Air Command and Staff College, Maxwell AFB AL, April 1987 (AD-A181-024).

19. Johns, Master Sergeant Justin W., NCOIC, Small Computer Training, Keesler Technical Training Center. Telephone Interview. Keesler AFB MS, 6 September 1988.

20. Karten, Naomi. "End-User Training: Analyzing the Investment," Information Strategy: The Executive's Journal, 3: 39-41 (Fall 1986).

21. Kleim, Ralph L. "In-House Training for Microcomputer Users," Administrative Management, 46: 50-51 (December 1985).

22. Large, Debbie, Logistics Support Specialist, Analysis and Training Group, Aeronautical Systems Division. Telephone interview. Wright-Patterson AFB OH, 10 August 1989.

23. Lee, Denis M. S. "Usage Pattern and Sources of Assistance for Personal Computer Users," MIS Quarterly, 10: 313-325 (December 1986).

24. Leitheiser, Robert L. and James C. Wetherbe. "Service Support Levels: An Organized Approach to End-User Computing," MIS Quarterly, 10: 336-349 (December 1986).

25. Madron, Thomas William. Microcomputers in Large Organizations. Englewood Cliffs, NJ: Prentice Hall, 1983.

26. McEwing, Richard A. and Gene L. Roth. "Evaluating CBT Evaluation," Training and Development Journal, 39: 32-35 (July 1985).

27. Newbold, Paul. Statistics for Business and Economics. Englewood Cliffs NJ: Prentice Hall, 1988.

28. Olague, Captain Albert, Chief, Computer Requirements, Air Force Communications Command. Telephone Interview. Scott AFB IL, 6 September 1988.

29. Patton, Ronald L., Chief, Training Division, Directorate of Human Resources, Air Force Logistics Command. Personal interview. Wright-Patterson AFB OH, 21 June 1989.

30. Resnick, Harold S. and Joel Fuerst. "Everything You Need to Know About Customer Training by Microcomputer Vendors," Training and Development Journal, 39: 84-87 (January 1985).

31. Schweinfurth, Kathy, Personnel Systems/Support Section, 2750th Air Base Wing. Telephone interview. Wright-Patterson AFB OH, 9 June 1989.

32. The Analytical Sciences Corporation (TASC). Welcome to Computer Based Training for Cost Analysis Functions. Dayton OH, April 1989.

Vita

Captain David M. Kondas [redacted] He enlisted in the Air Force as a Financial Disbursement Specialist and entered active duty in October 1975. He was stationed at Charleston AFB, S.C. until October 1979 when he separated to complete his bachelor degree. He entered the USAF ROTC program at the University of Maryland in July 1981 where he became the Cadet Corps Commander in his senior year. He graduated with a Bachelor of Science degree in Management as an ROTC Distinguished Graduate, and was commissioned in August 1983. He entered active duty as a second lieutenant in September 1983 as the staff Cost and Management Analysis Officer for the 9th Strategic Reconnaissance Wing at Beale AFB, CA. He was the Company Grade Officer of the Year for the 9th SRW and the 14th Air Division in 1985. He was also the Strategic Air Command Cost and Management Analysis Officer of the Year for 1985. He was assigned to Ankara, Turkey in June 1986 where he served as the Cost Analysis Officer for Headquarters, the United States Logistics Group. He entered the School of Systems and Logistics, Air Force Institute of Technology, in June 1988.

[redacted]

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for Public Release; Distribution Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFIT/GCA/LSQ/89S-7	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION School of Systems and Logistics 6b. OFFICE SYMBOL (If applicable) AFIT/LSQ	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Air Force Institute of Technology Wright-Patterson AFB OH 45433-6583	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

A Comparison of Microcomputer Training Methods and Sources

12. PERSONAL AUTHOR(S)
David M. Kondas, B.S., Capt, USAF

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
MS Thesis	FROM _____ TO _____	1989 September	112

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Microcomputers Training Cost-Benefit Analysis Productivity
12	06		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Thesis Advisor: Jeffrey C. Daneman
Associate Professor
Department of Quantitative Management

Approved for public release: IAW AFR 190-1.

LARRY W. EMMELHAINZ, Lt Col, USAF 11 Oct 89
Director of Research and Consultation
Air Force Institute of Technology (AU)
Wright-Patterson AFB OH 45433-6583

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Jeffrey C. Daneman, Assoc. Professor	22b. TELEPHONE (Include Area Code) (513)-255-8409 22c. OFFICE SYMBOL AFIT/LSQ

DD Form 1473, JUN 86 *Previous editions are obsolete.*

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

The purpose of this study was to evaluate the methods and sources of microcomputer training currently used in the Air Force in terms of their overall value to the job, training effectiveness, and level of competency achieved upon training completion. The three methods studied were classroom instruction, video-based training, and computer-based training (CBT). The three sources studied were in-house training functions, government-contracted training, and private (e.g., colleges and universities). One hundred and fifty-one government employees rated each method and source of PC training they had experienced.

Classroom training was found to be the most often used and the most popular method of PC training, regardless of source. The preference of delivery method was classroom, CBT, then video-based training, regardless of source.

A cost-benefit analysis was performed to compare the two most often used sources of classroom training: in-house and government-contractor. Statistical results indicated that the two sources are equal in terms of the benefits stated above; cost-per-training hour was slightly lower for vendor-provided training than for in-house training. Resources required to establish and maintain in-house training functions were substantially greater than those required to support vendor-provided training programs.

The study found that college or university PC training was rated equally with in-house and commercial sources of classroom, CBT, and video-based training. One particular recommendation, in light of the challenge presented to managers for improving microcomputer training in the workplace, is to investigate the possibility of training government employees by contract with local educational institutions. Potential benefits include better trained and educated employees, higher morale, and savings of operations and maintenance funds.